The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

January 1945

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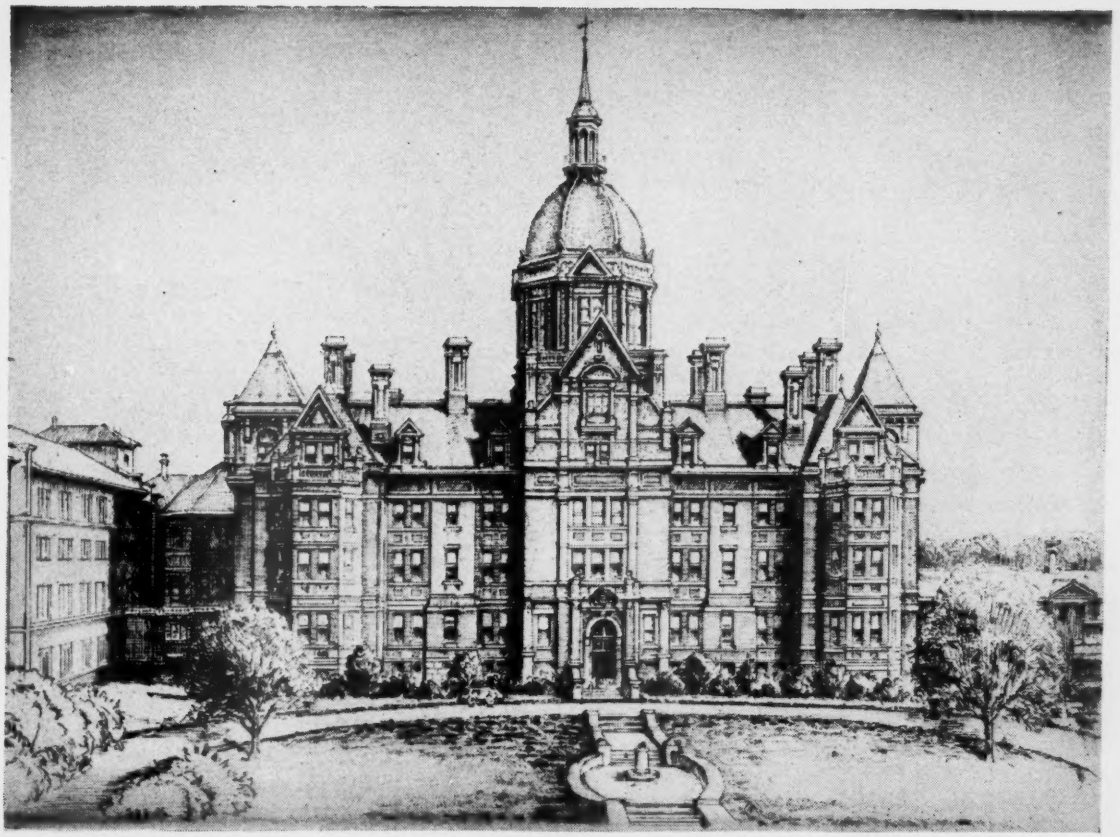

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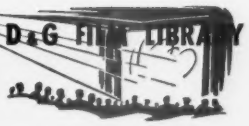

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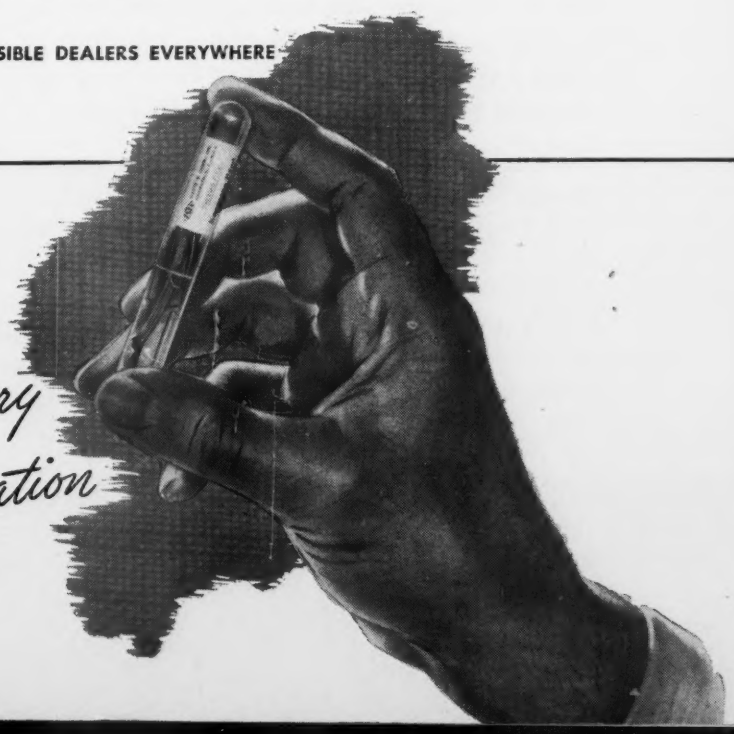

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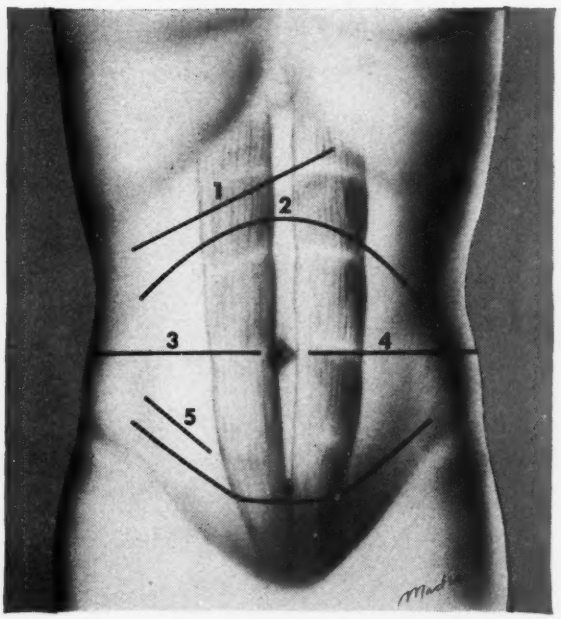

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Editorial

Rationale of Burn Therapy . . . . . *Lieut. Comdr. Gerald H. Pratt* 1

Original Articles

Modification of the Plasma Fixation Method (Sano) of Skin Grafting by the Use of Bobbinet and a Mirror Attachment . . . . . *John A. Jenney* 3

Administration of Intravenous Fluids to Surgical Patients . . . . . *Paul F. Fox* 8

Vaseline Gauze Contact Fixation of Split Thickness (Padgett) Skin Grafts . . . . . *William M. Roberts and Howard J. Schaubel* 16

Contents Continued on Page 3

ANALGESIC
SPASMOLYTIC
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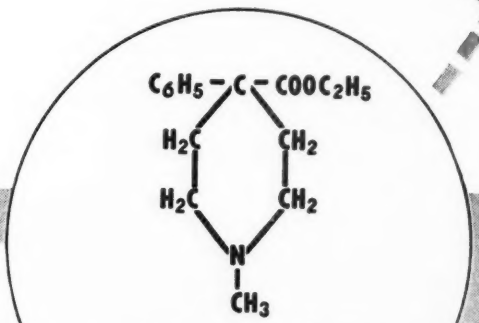

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Contents • January, 1945

Jaundice. Surgical Considerations . . . . . *Stanley Eiss* 23

Wound Healing. An Experimental Study of Water Soluble Chlorophyll Derivatives in Conjunction with Various Antibacterial Agents . . . . . *Lawrence W. Smith and Alfred E. Livingston* 30

Gangrene and Perforation of the Gallbladder . *C. A. Bachhuber, Paul H. Deeb and E. A. Taylor* 40

Tuberculosis of the Breast. Report of Nine Cases Including Two Cases of Coexisting Carcinoma and Tuberculosis . . . . *Roland I. Grausman and Meyer L. Goldman* 48

Cholecystitis. The Advantages of Operative Treatment in Definite Unmistakable Disease . . . . . *Francis X. Timoney* 57

Clothespin Graft of the Spine for Spondylolisthesis and Laminal Defects . . *David M. Bosworth* 61

Conization and Early Diagnosis of Carcinoma of the Cervix . . . . . *Josef J. Haber* 68

Modified Treatment for Fracture of the Head of the Radius . . *Captain R. W. Postlethwait* 77

Rôle of Lymphoid Hyperplasia in Acute Appendicitis . . . . . *H. Rembert Malloy, Robert S. Jason and Charles R. Drew* 81

Muscle Hernias of the Leg. Review of Literature and Report of Twelve Cases . . . . . *Major Harold E. Simon and First Lieut. Hugo A. Sacchet* 87

Greater Efficiency in Steam Pressure Sterilization of Surgical Supplies . . . *Theodore E. Wade* 98

Handling of War Casualties . . . . . *Joseph K. Narat* 106

Case Reports

Total Pneumonectomy for Benign Bronchial Adenoma. Case Report . . . . . *M. Dawson Tyson and N. T. Milliken* 111

Regional Jejunitis. Report of an Unusual Case . . . . . *Vincent L. Rees* 119

Congenital Diaphragmatic Hernia. Visceral Strangulation Complicating Delivery. . . . . *J. W. Thompson and Leo J. Le Blanc* 123

Neurofibroma of the Carotid Body . . . . . *Edward Goodsitt and George Sudimack* 131

Perforated Ulcer of Esophagus Following a Burn . . . . . *L. M. Rankin* 134

Bronchocolic Fistula . . . . . *Russell Buxton and Rachelle L. Kurman* 137

New Instruments

Improved Thyroid Flap Retractor . . . . . *William P. Eckes* 140

Resuscitator Incubator . . . . . *Lieut. Col. Harry M. Kirschbaum* 142

General Information on Page 4 *Advertising Index on 3rd cover*

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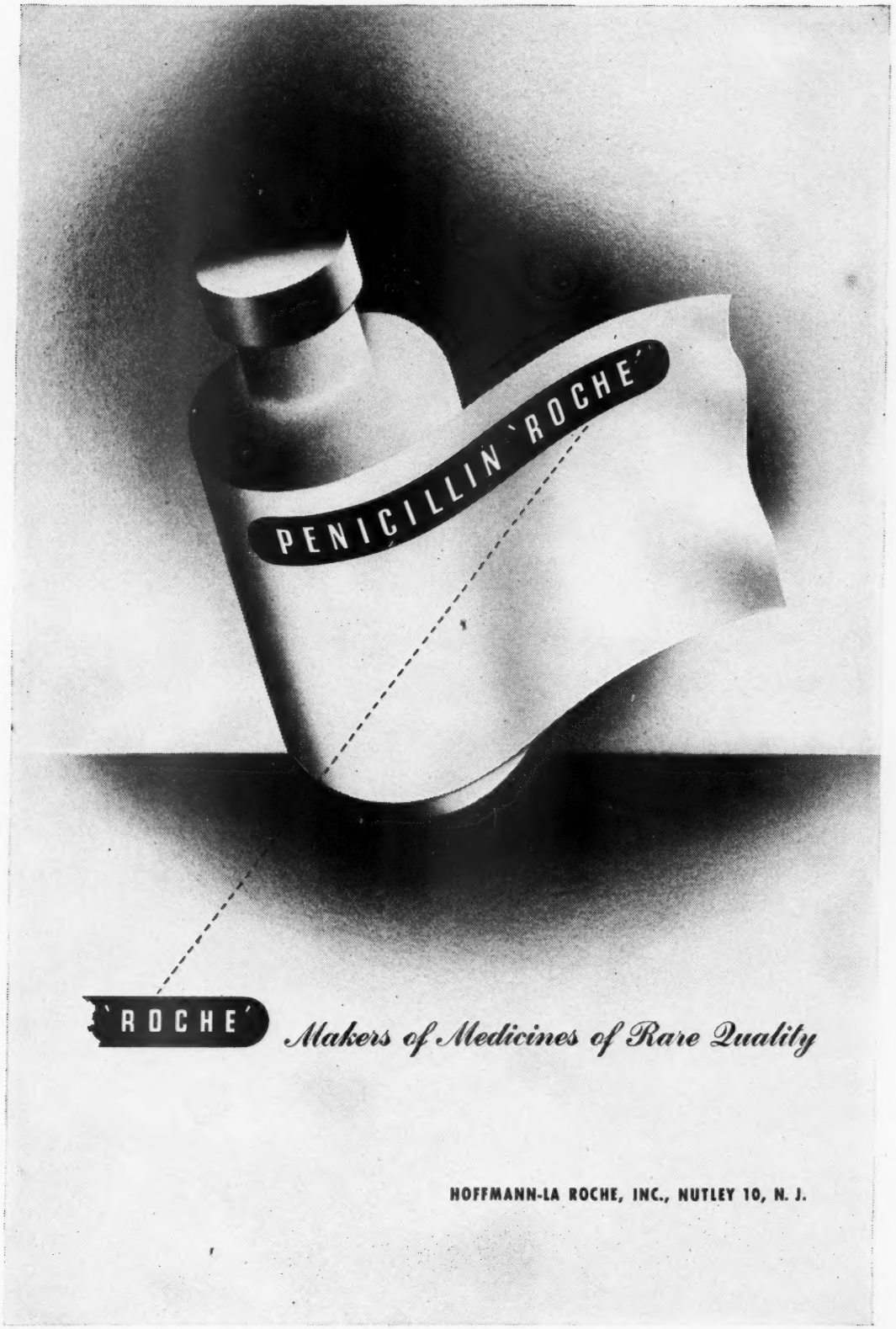

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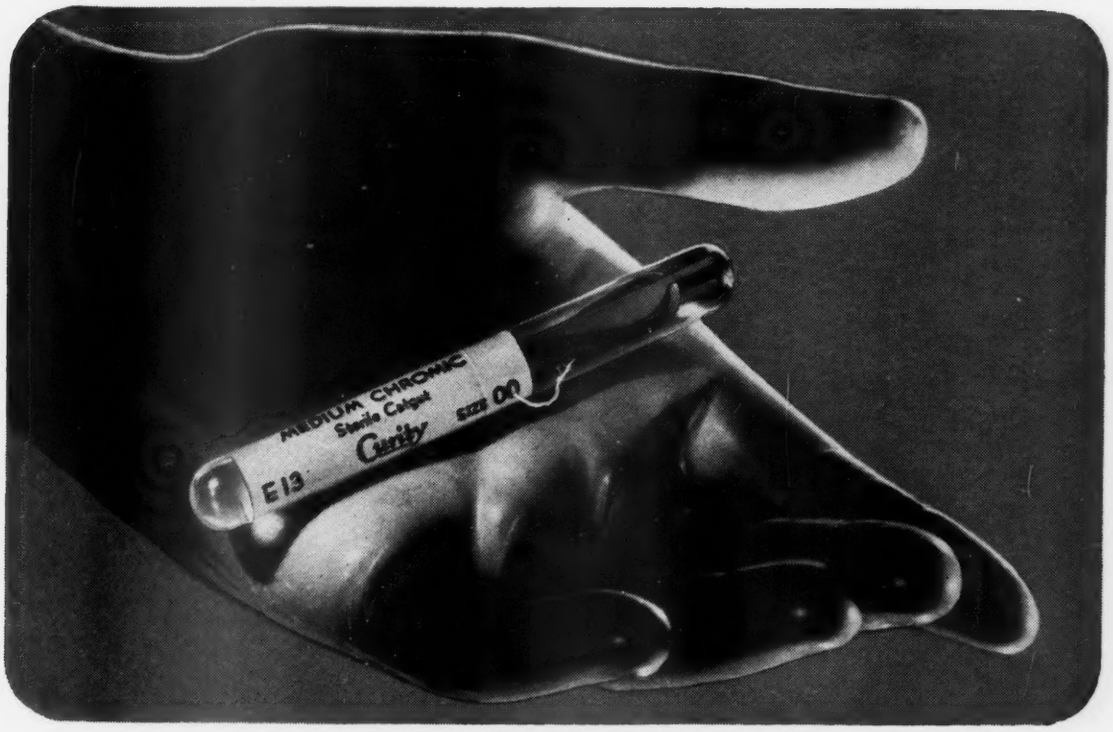

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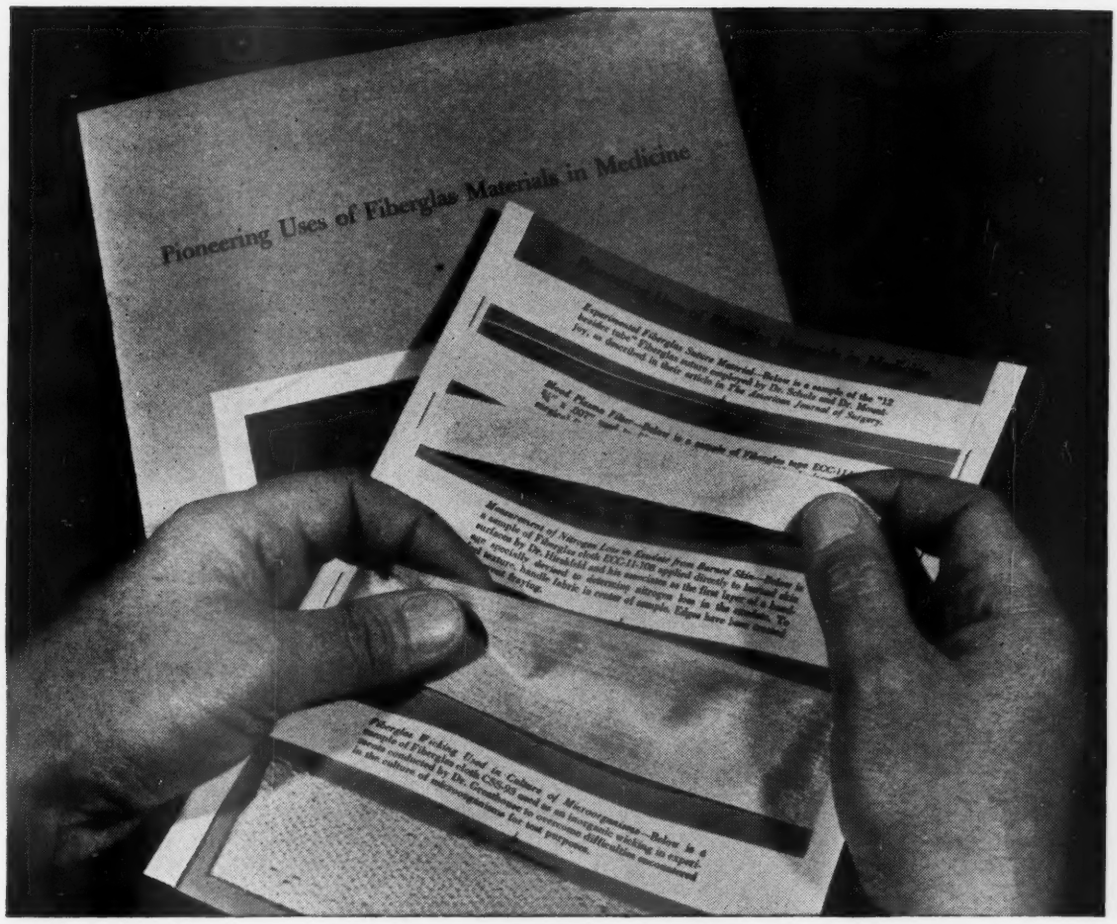

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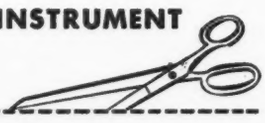

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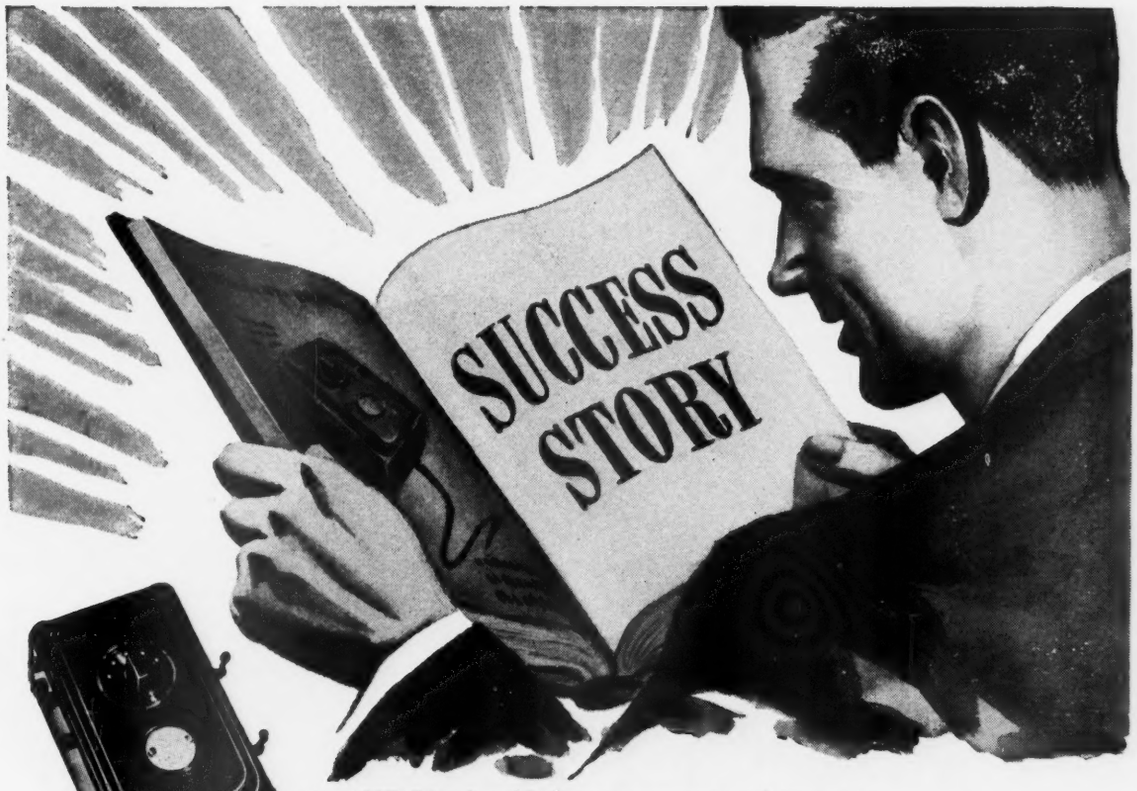

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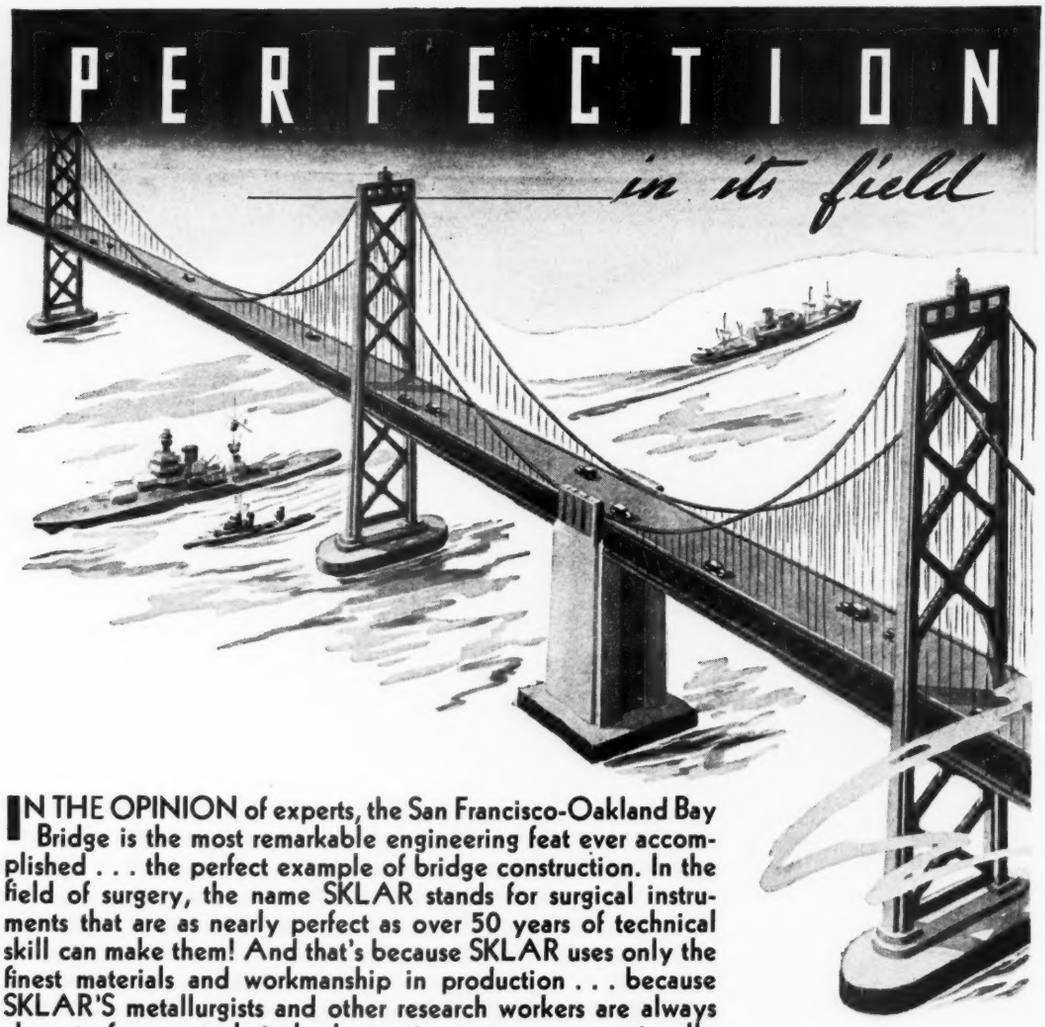

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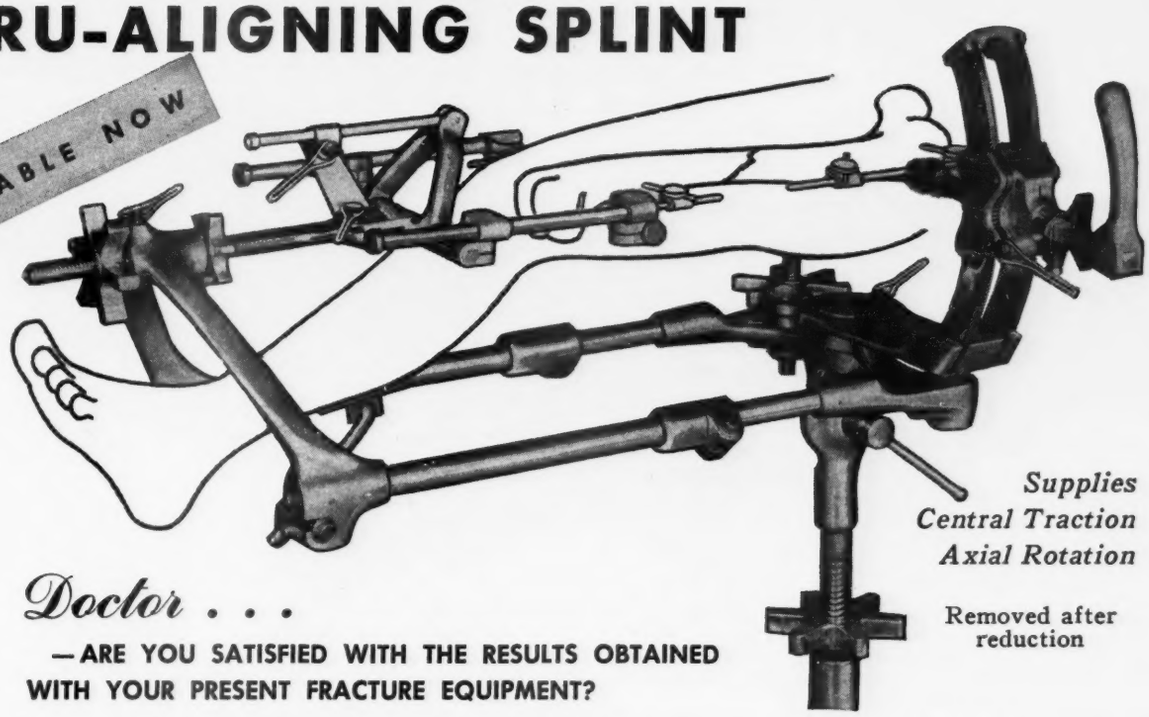

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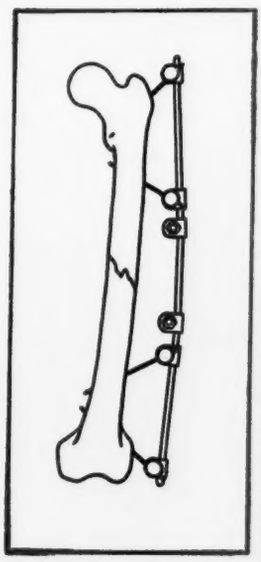
With the TRU-ALIGNING SPLINT the transfixions of choice can be placed at any angle, in any plane, at any preferred distance, and from opposite sides if indicated.



A light duraluminum fixation rod, weighing 2 ozs., will maintain the reduction.

Please send me Booklet on Fracture Technic ..... ☐

Please have Technician call to demonstrate without obligation ..... ☐

Name.....

Address.....

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The TOWER COMPANY, Inc.

Manufacturing and Research Specialists in Fracture Equipment

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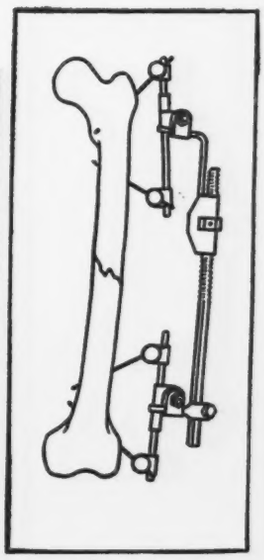


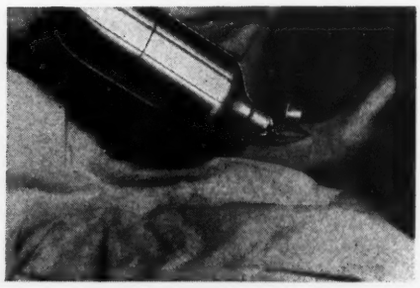
An adjustable fixation unit will keep the ends of the bones in apposition at all times.

THE Luck BONE SAW

Saves Time in Surgery

Prominent surgeons and leading hospitals have been finding the Luck Bone Saw a time and labor-saver in this day of overworked medical staffs.

Its high speed makes possible the use of very small diameter slotting burrs. The lower speed, at the opposite end, is ideal for inserting Steinman Pins and Kirschner Wires, as well as for sawing bone and drilling. Variable speed is obtained by foot-controlled rheostat. Complete motor unit and cord can be sterilized in autoclave.

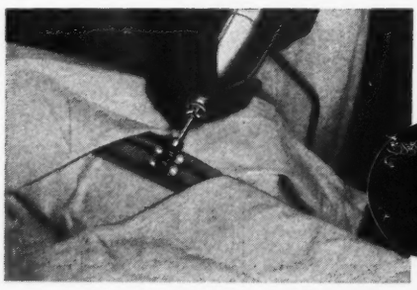


Used with cutting burr in osteoplastic procedures on smaller bones. Here a graft is being cut for fusion of metatarso-cunieform joint. The cutting burr has a multitude of uses.

The Luck Bone Saw is shown here in use with a slotting burr for transverse end cuts during removal of bone grafts. Longitudinal cuts have previously been made with circular saws.

A special shaped burr is used for curreting and saucerizing a chronic osteomyelitic focus. The same burr may be similarly employed in curreting bone cysts or benign giant cell tumors.

The Luck Bone Saw in fitted case with complete equipment.



Used with twin circular saws. They rotate up to approximately 2000 R. P. M. Have great power. Do not jam or burn the bone. Second blade readily removed when only single blade is desired.

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Imagine operating under the conditions illustrated above. And yet this scene depicts surgery as practiced quite recently—in the early nineteenth century.

Advances in surgery and medicine in the last 150 years have been almost unbelievable, truly miraculous—and Pilling, since its founding in 1814, has seen these advances from a close observer's and collaborator's viewpoint.

Throughout the years, Pilling's close cooperation with leading surgeons and physicians has led to the development of many new, improved instruments. Pilling's insistence on painstaking craftsmanship and superior materials has produced truly fine aids to the growing skill of surgeons. Instead of the "Surgeons' Wares" of 1814, today Pilling provides a complete line of surgical and hospital supplies. George P. Pilling & Son Co., Dept. A, Philadelphia 3, Pa.

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The value of an antiseptic is determined by its ability to destroy bacteria effectively, yet leave the tissues unharmed.

Ceepryn—new non-mercurial germicide—employed in 18,000 surgical cases over a three-year period, has demonstrated *effectiveness* with *tolerance.* "During this time there has been observed no irritation . . ."*

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Ceepryn Aqueous Solution 1:1000—pints, gallons.

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*Kramer, G. B., and Sedwitz, S. H.: Ceepryn: clinical and bacteriological studies, Am. J. Surg. 63:240-245 (Feb.) 1944

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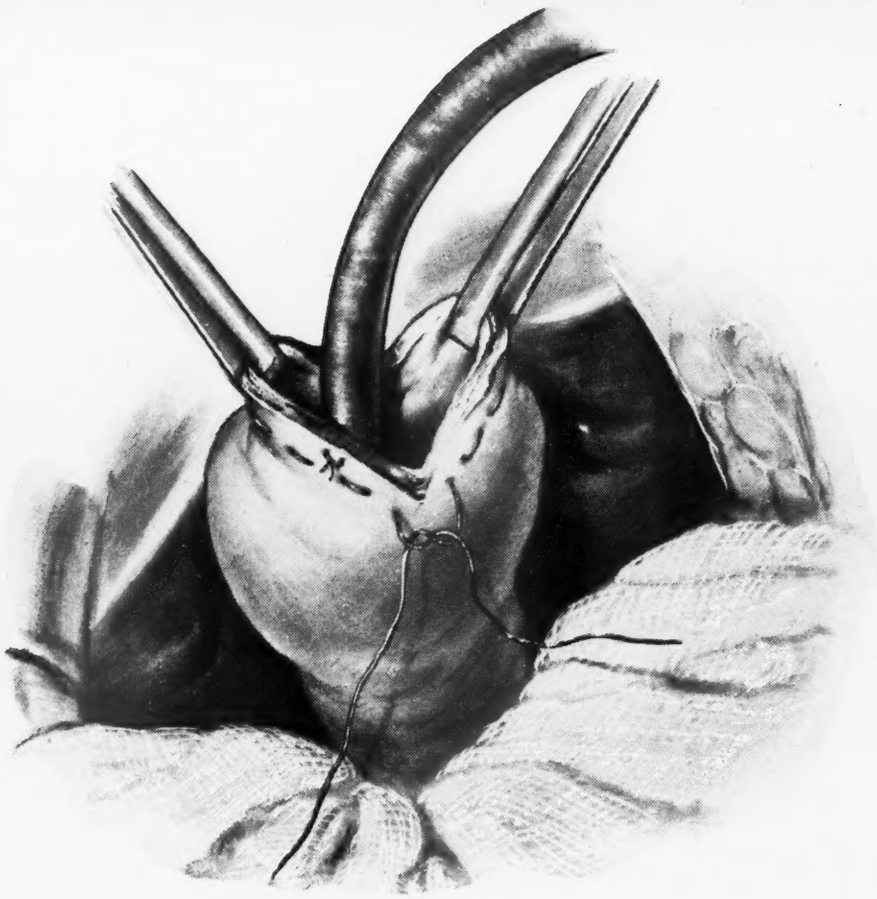

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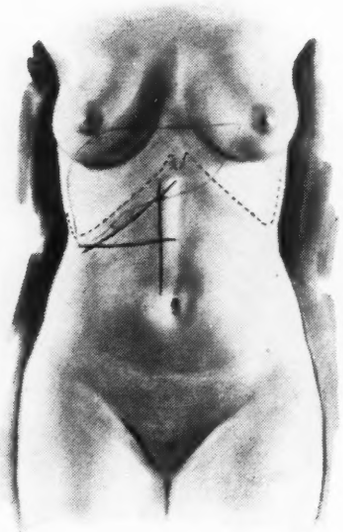
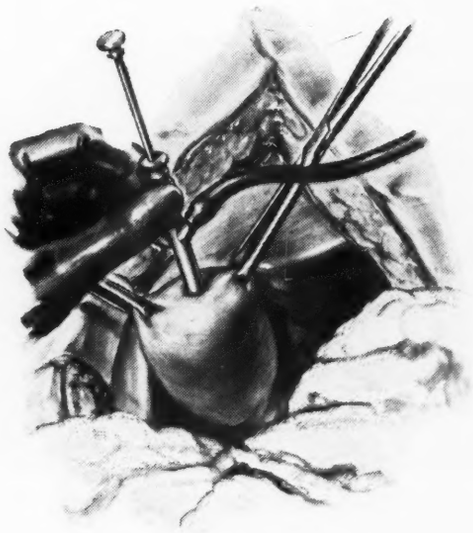
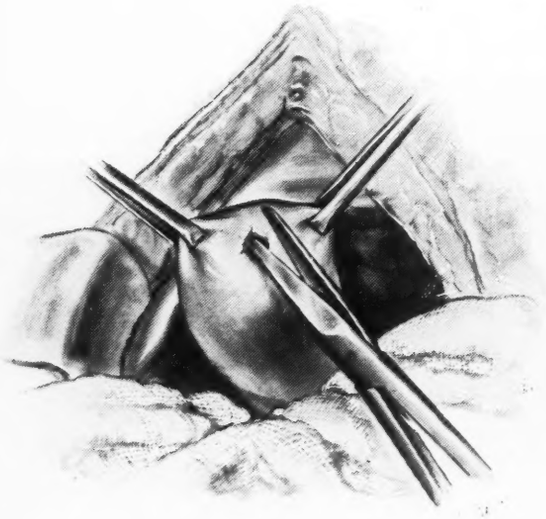


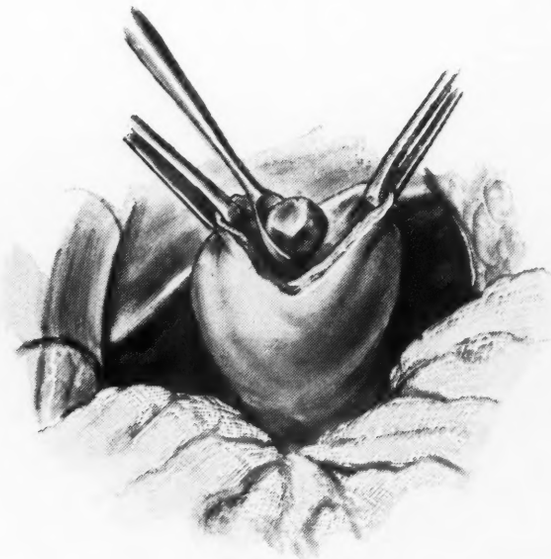
1 Three of the commonly used incisions: oblique, transverse and right rectus.



2 Fluid contents of gall bladder suctioned off through trocar and cannula.

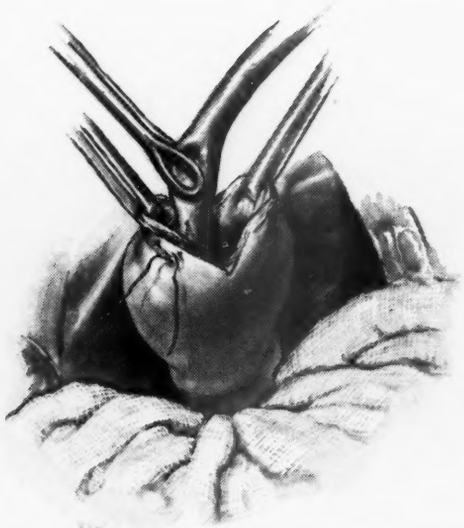


3 Opening in gall bladder enlarged.

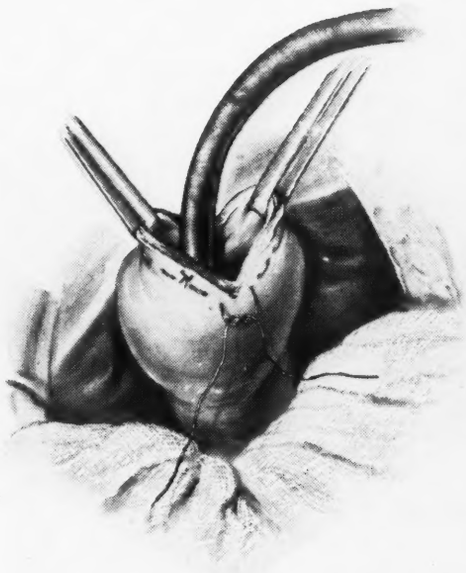


4 Extraction of calculi from gall bladder.

TECHNIC IN CHOLECYSTOSTOMY



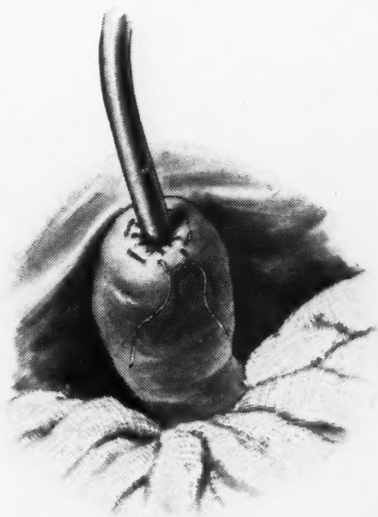
5 Drainage tube fixed in gall bladder by suture, to hold tube in place and facilitate inversion closure.



6

6-7-8 Closure of gall bladder effected by 2 or 3 layers of invaginating purse string sutures.

7



8

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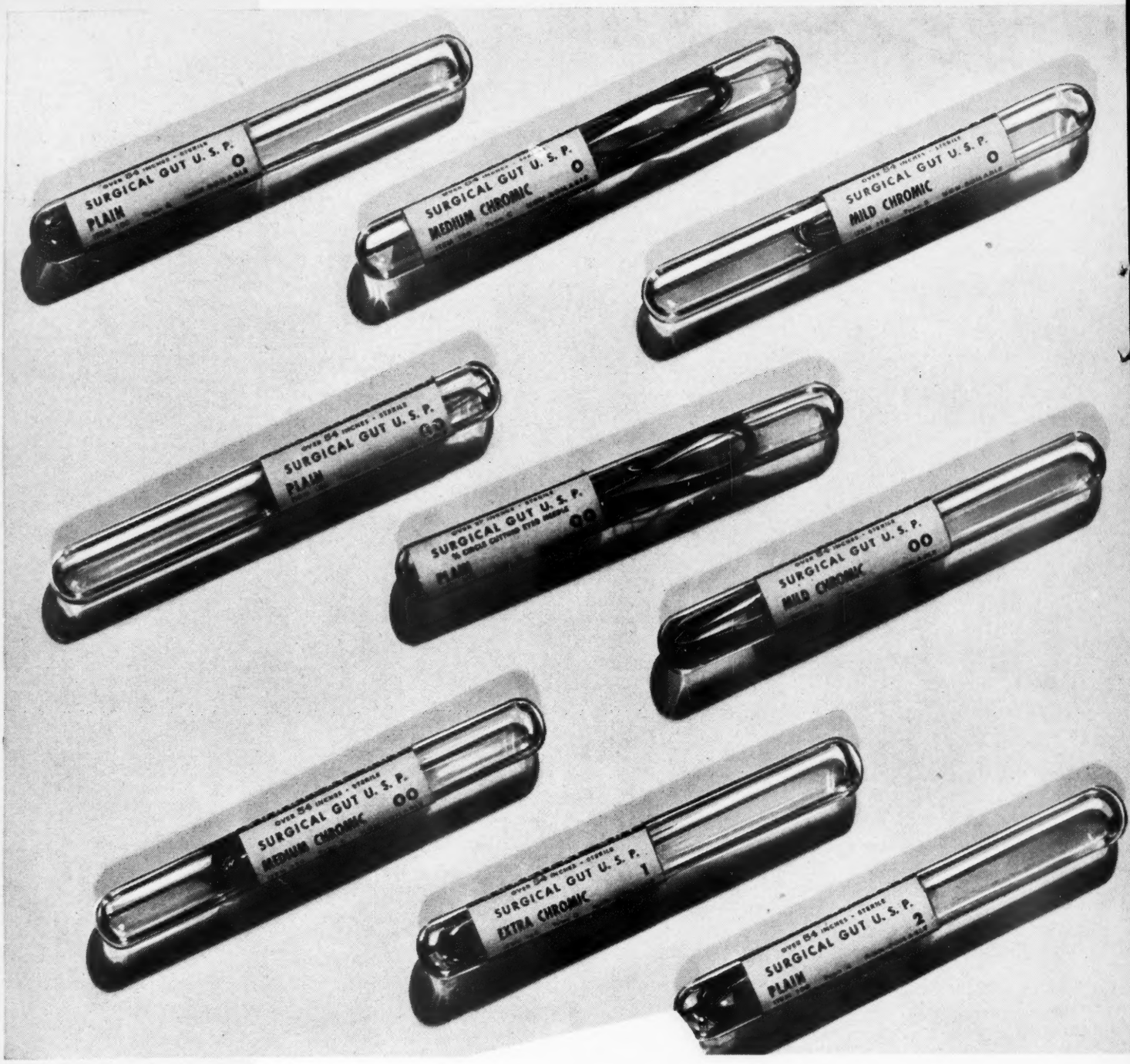

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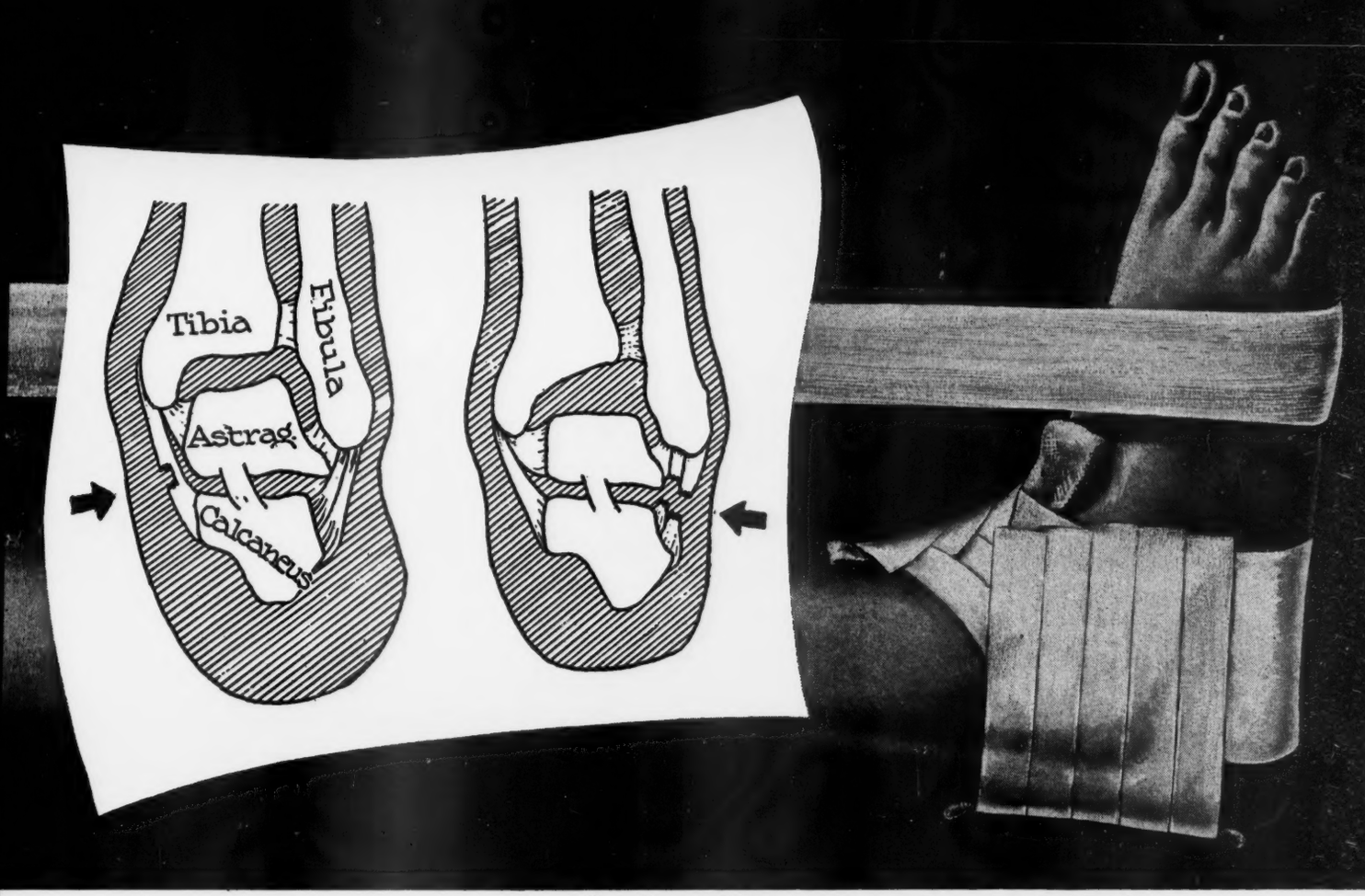

(Illustration from "Therapeutic Uses of Adhesive Plaster" published by Johnson & Johnson)

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• A primary use of adhesive plaster is to pull tissues into place and hold them. In all strappings the first strips should be applied parallel with the fibres of the underlying muscle, fascia, tendon or ligament, for good anchorage. Subsequent strips are applied in logical directions.

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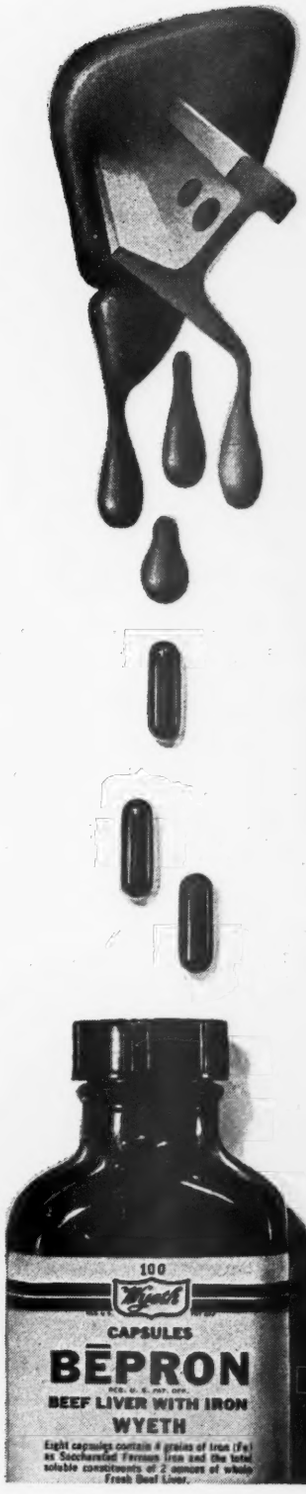

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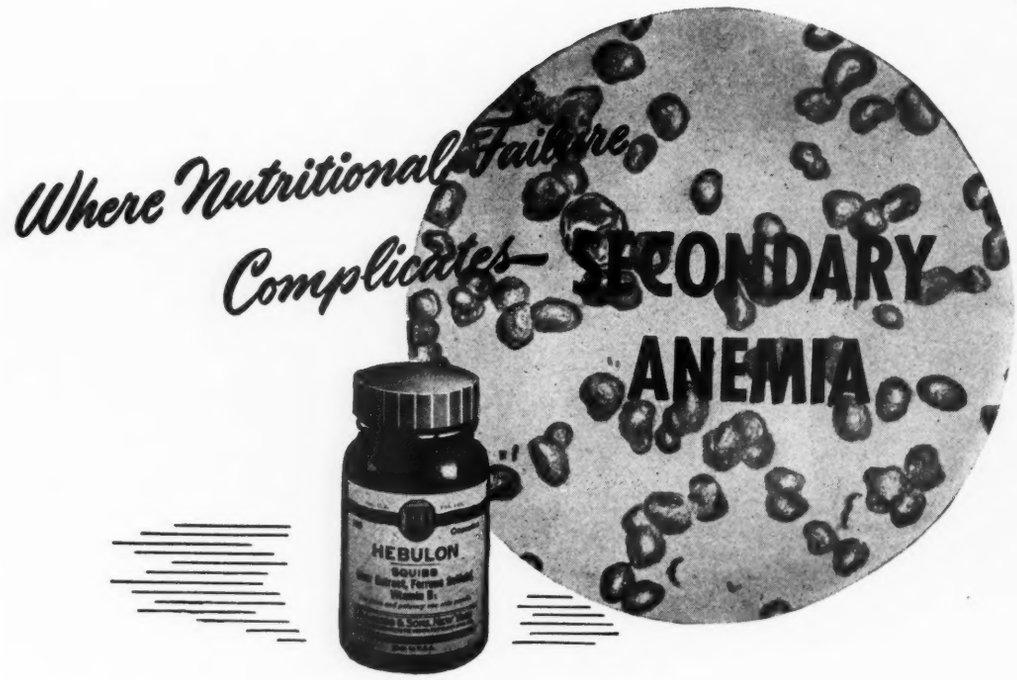

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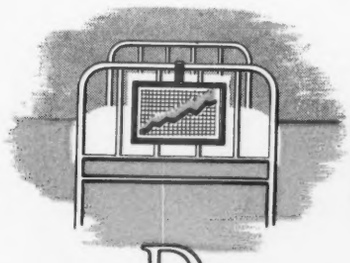

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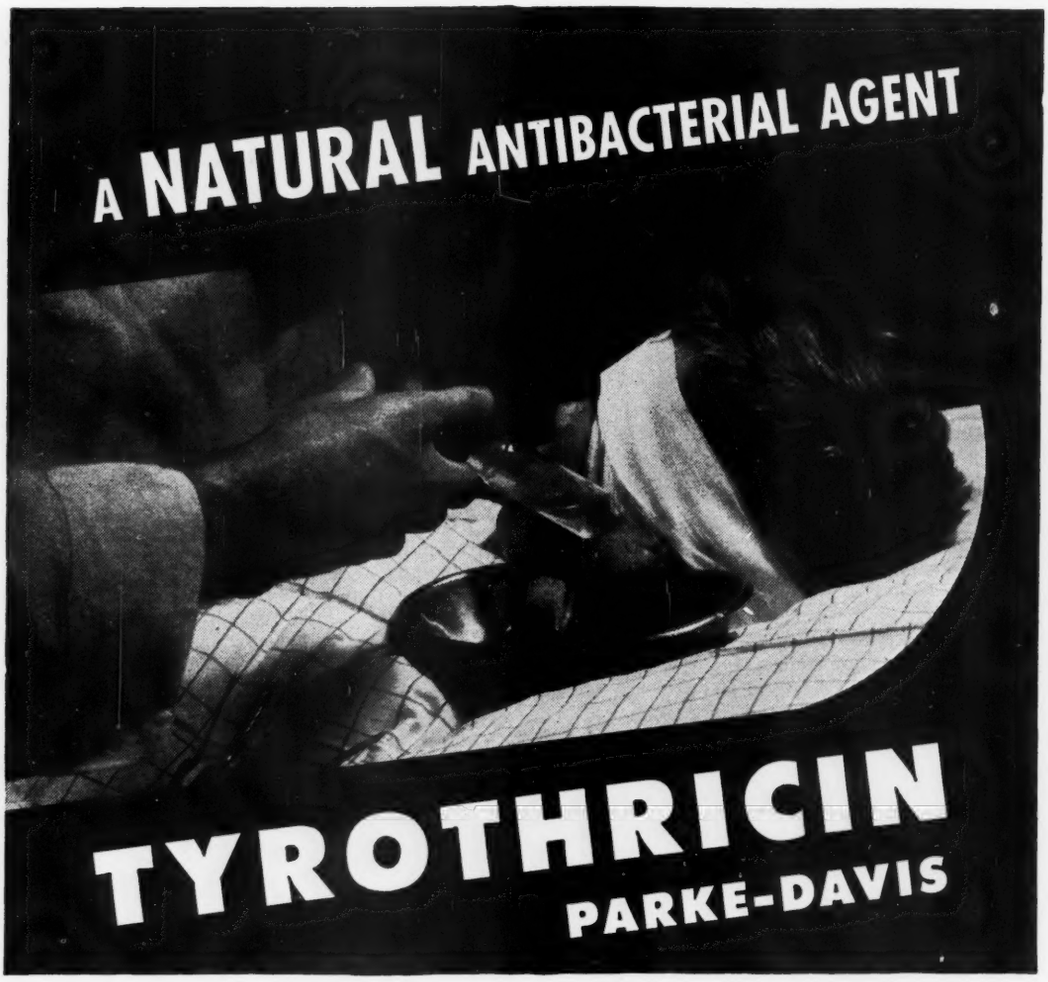

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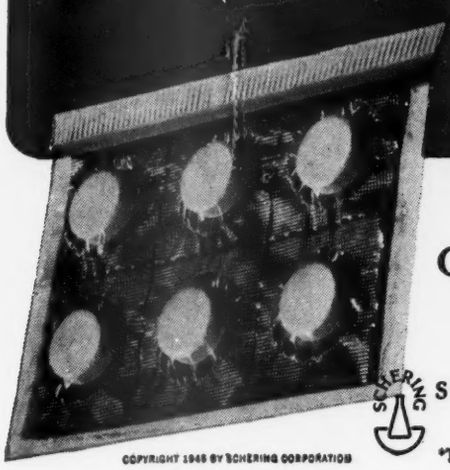

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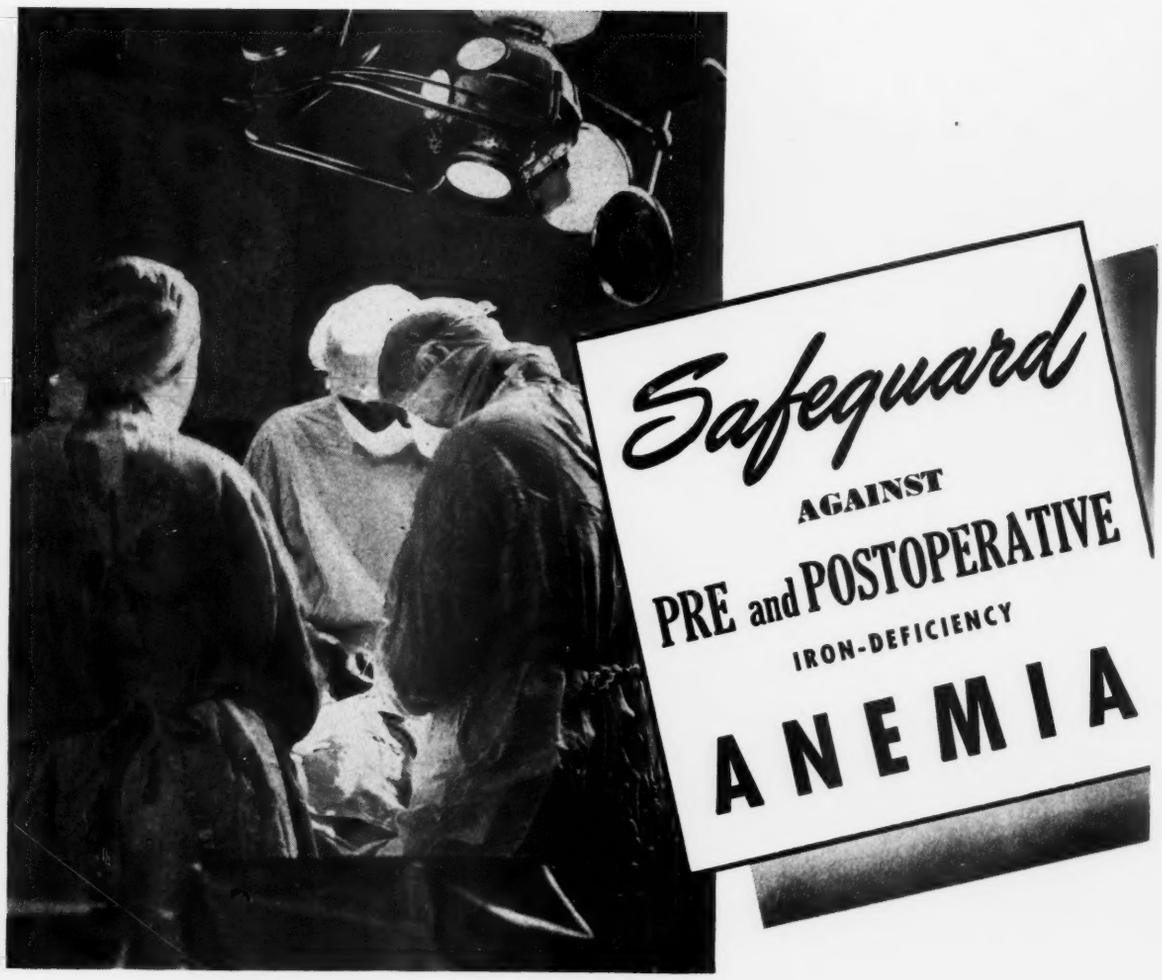

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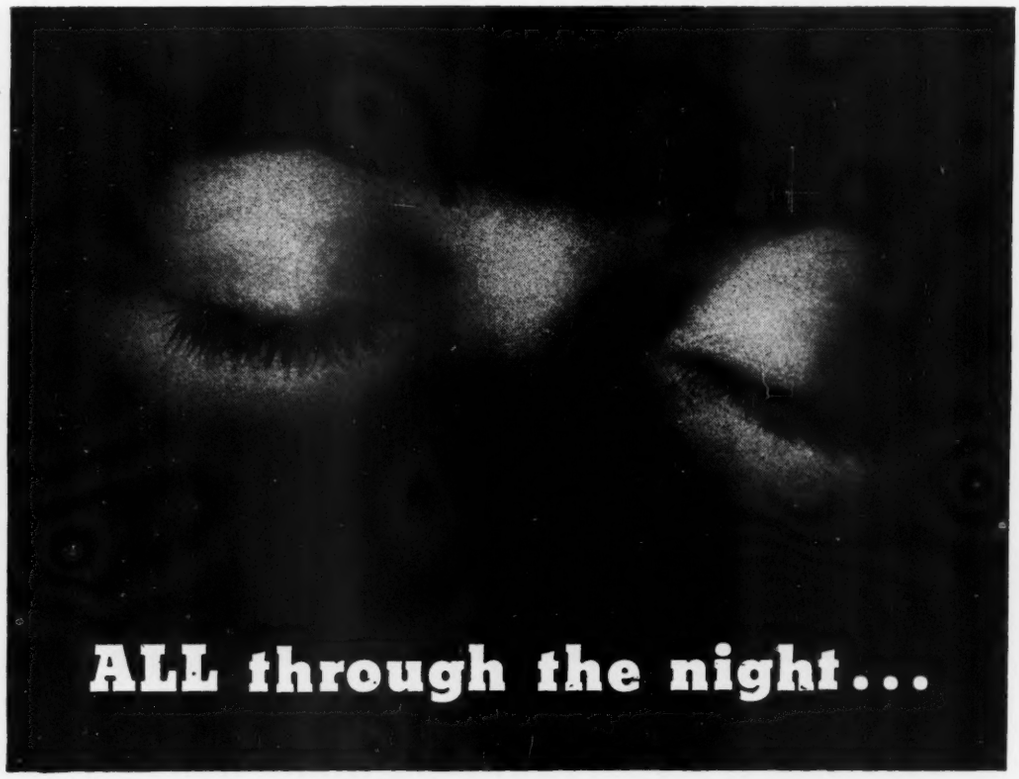

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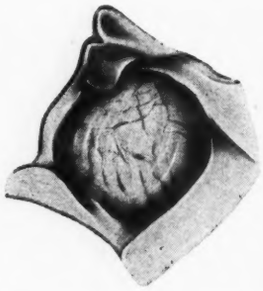

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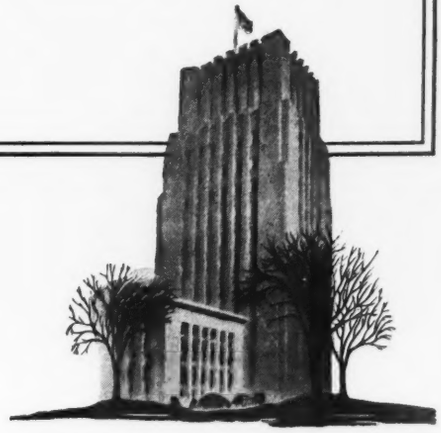

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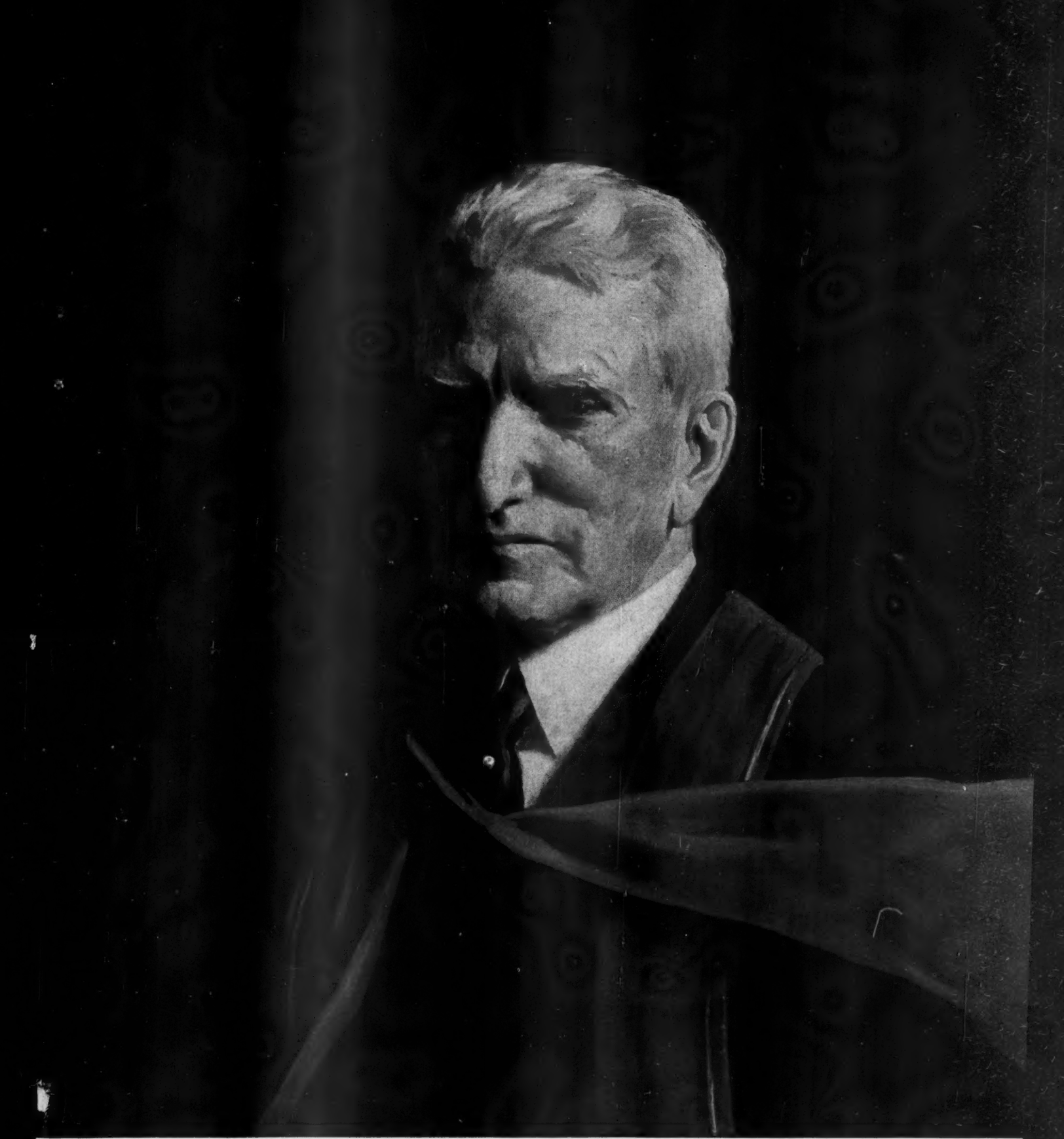

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Franklin Martin

1857-1935

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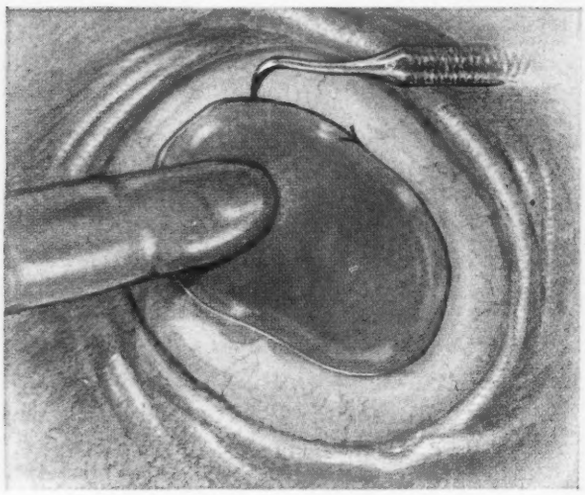
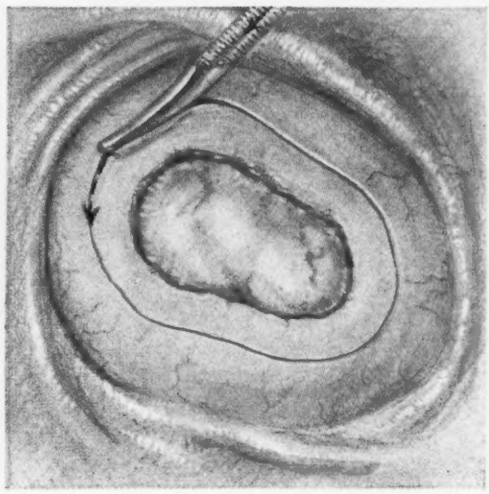
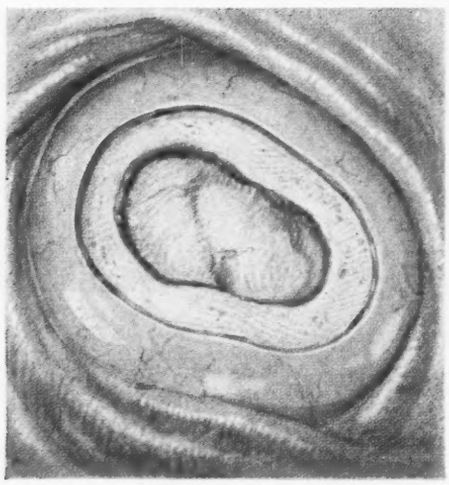


1. A tantalum plate of correct size and shape is placed over the defect and outlined by a scriber.

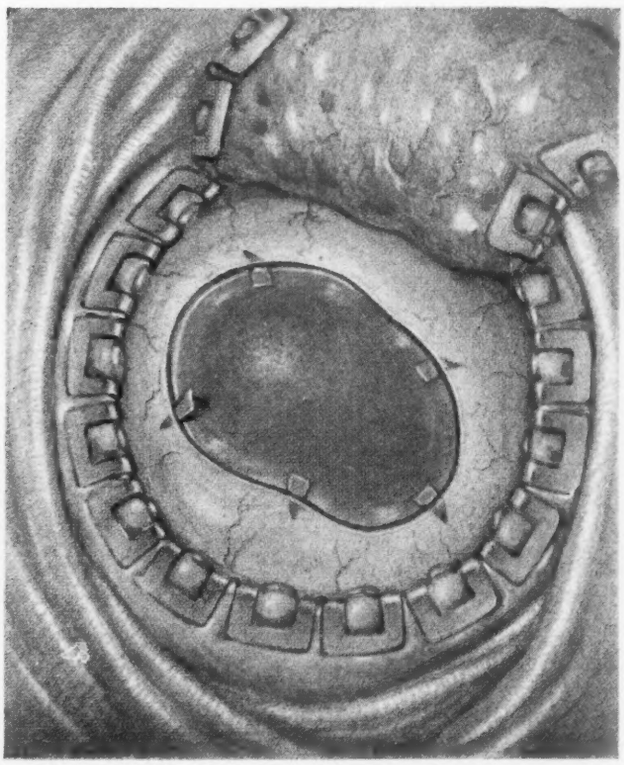


2. A lineator with cutting edge cuts the outer skull table, following the plate outline.

Skull Repair



3. A shelf is formed by chiseling away a thin layer of outer skull table from edge of defect to groove cut by lineator.



4. Tantalum plate set on bone shelf and secured by triangular tantalum points. Point holes are made by a flat triangular gouge and points pressed downward.

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Some of the suggested applications of Ethicon Tantalum are shown on these pages. The distribution of Tantalum for civilian as well as military surgery represents another outstanding expansion of Ethicon service. All Tantalum products for surgical use are available exclusively through Ethicon Suture Laboratories.

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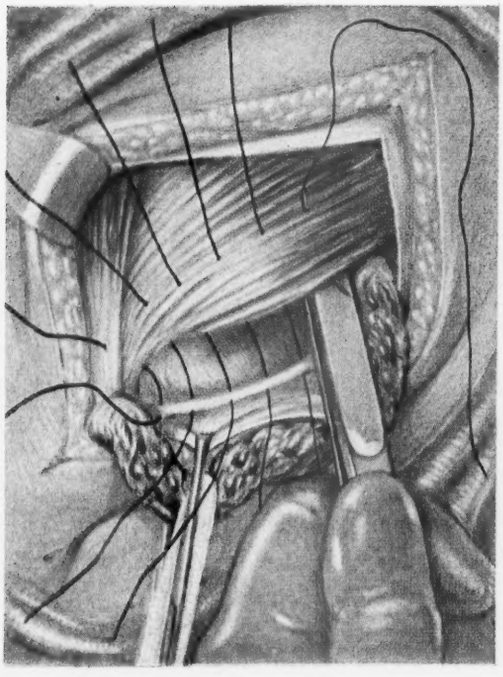

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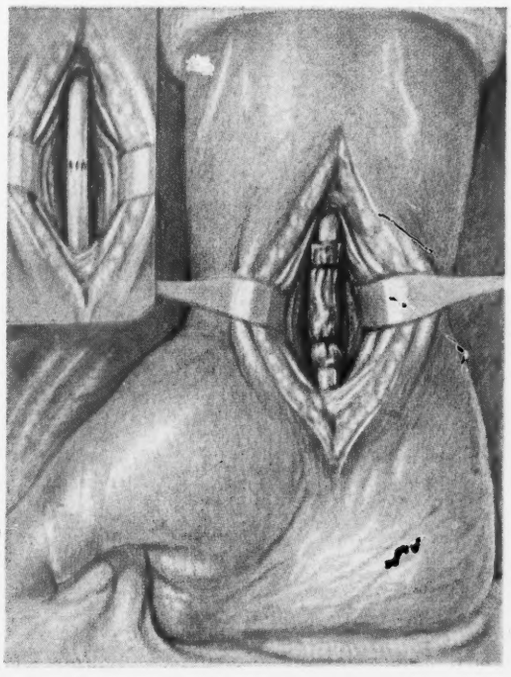
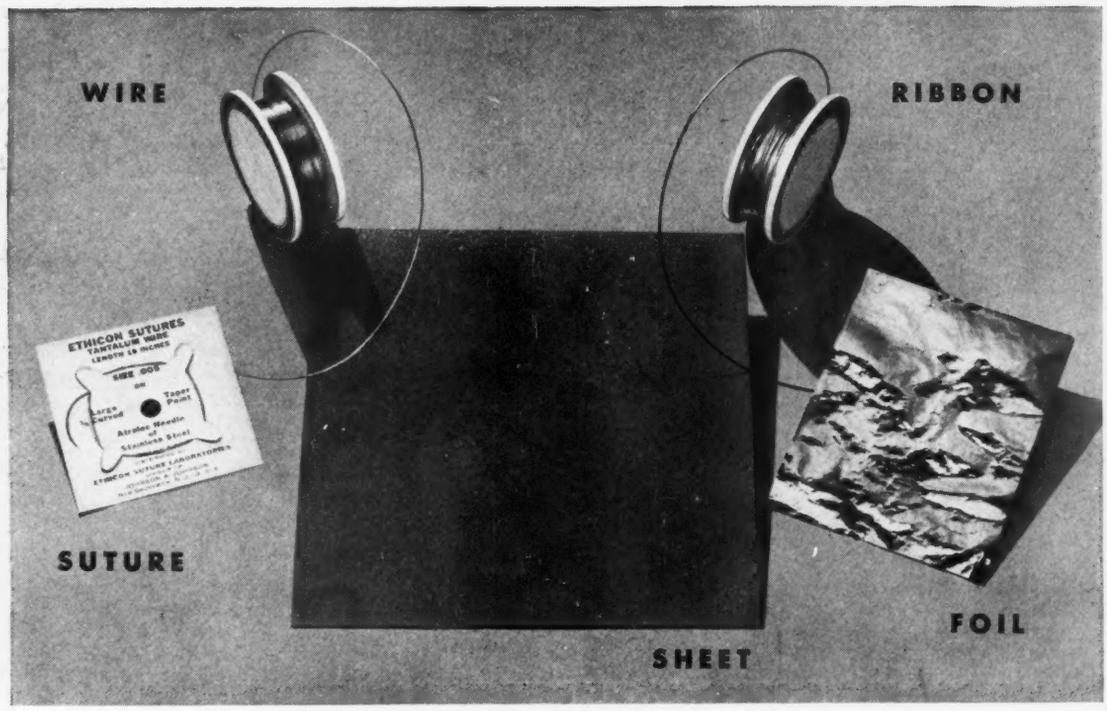
Modified Bassini operation. Tantalum sutures approximating external oblique aponeurosis to Poupart's ligament. Of value in recurrent hernia or in infected areas.



Nerve Repair

(Inset) Fine gauge tantalum sutures approximate epineurium of severed median nerve... Tantalum foil wrapped loosely about repaired section and secured by loose ties.



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NEW SERIES VOL. LXVI JANUARY, 1945 NUMBER ONE

Editorial

THE RATIONALE OF BURN THERAPY

THE gasoline age quadrupled the incidence of burns. Hi-octane gasoline for airplanes further increased the number of burn cases. With the war we all have become burn conscious, especially those of us in the service. Two-thirds of the Naval casualties at Pearl Harbor were due to burns. On one hospital ship in the South Pacific 360 burns were treated in one year, an average of one a day. At the U. S. Naval Base Hospital in the same area, 154 patients were admitted with an involvement of from 5 to 90 per cent of the body. In war, flash burns, plane crashes, electric accidents and explosions are all important factors. Carelessness, however, is still the prime cause as witnessed by the fact that 50 per cent of the burns seen at this hospital were caused by the 100-octane gasoline used to start brush fires and galley stoves. This figure illustrated well the part negligence played as battle casualties were being admitted daily at that time.

The publication of many articles on burns in which successful results of therapy are attributed to certain local measures has confused the picture. When one travels from one base hospital to another a familiar question is, "What are you using on burns now?" Such questions indicate that in the minds of many the rationale of burn therapy is still not clear. Successful therapy of burns is not based on local measures. Patients now survive burns of a proportion of the body surface previously considered fatal. In the past, these patients died because reliance was placed on some local therapy of the burned area without appreciation of the underlying pathological processes inaugurated by the burn.

Today, the treatment of a burn can be well outlined. Survival or death may well depend upon: (1) Treatment of shock by the prevention of hemoconcentration, the replacement of tissue fluid lost, and the prevention of further loss; (2) the prevention of secondary infection. In this treatment, local therapy can aid only in the prevention of fluid loss by pressure, and also can minimize the incidence of infection. A simple aseptic petrolatum or vaseline pressure dressing has been found effective and is used in both the Navy and Army Medical Services.

Treatment thus can be summarized: *General*—(1) Intravenous plasma to prevent hemoconcentration and replace fluids already lost; (2) morphine for the relief of pain; and (3) prophylactic tetanus toxoid and gas gangrene serum as well as sulfa drugs and penicillin to reduce possibility of infection. *Local*—(1) Apply dressings under sterile (operating room,

including cap, gown and mask) precautions at first available facility. Do not débride. Where gross contamination requires it, cleanse carefully with mineral oil. (2) Apply sterile vaseline or petrolatum dressings and wrap firmly and evenly. If desired, sulfa powder or penicillin may be applied under the vaseline. Do not disturb the dressings for a minimum of two weeks unless complications require it. (3) Prevent contractures by correct splinting and early grafting.

The local use of petrolatum is but a return to one of the earliest treatments of a raw area. Its merit lies in the absence of any tissue-injuring chemical and its value is dependent upon the pressure wrapping to prevent fluid loss. When combined with the systemic treatment of the accompanying shock, it is most satisfactory.

No type of dye or ointment, paraffin or plaster of paris cast placed over a burn can replace these fundamental therapeutic principles.

Lieut. Comdr.
Gerald H. Pratt, m.c., u.s.n.r.

From a severe burn there is an early permeability of capillaries leading to the rapid loss of blood serum and such hemoconcentration that the smaller blood vessels may become more or less obstructed by red cells. The plasma largely escapes into the tissues and cavities of the body, but considerable quantities may ooze from the burned surfaces unless the burn is so deep as to produce eschar or carbonization.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

Original Articles

A MODIFICATION OF THE PLASMA FIXATION METHOD (Sano) OF SKIN GRAFTING BY THE USE OF BOBBINET AND A MIRROR ATTACHMENT*

JOHN A. JENNEY, M.D.
NEW YORK, NEW YORK

BECAUSE of difficulties encountered in the application of skin grafts after the method of Dr. Sano, we devised methods which have helped eliminate many of them. These involve the use of bobbinet on the drum of the Padgett dermatome and a mirror which is attached to the cutting arm.

Among these difficulties were removing of the graft from the dermatome; contraction of the graft and the sticking of its cemented surface to adjacent surfaces; holding the graft on the recipient area long enough for it to stick, this difficulty mounting in proportion to the irregularity of the surface to be grafted; the necessity of cutting a much larger piece of skin than the area to be covered, because contracted skin can be worked better than taut skin; mutilation of thin grafts when separating them from the dermatome; and interference of vision of the operator produced by the drum during the manipulation of cutting the graft, thereby making any changes in the thickness of the graft or its broad contours difficult.

The method we have been using with success is as follows: A large piece of fine cotton bobbinet is thoroughly washed in soap and water, stretched with pins to its original dimensions and firmly pressed to flatten the threads. Smaller pieces are then cut from the large piece, each one about one inch larger in all directions than the area of the drum of the Padgett dermatome. The drum of the Padgett dermatome is painted with rubber cement and allowed to dry for a few minutes. A piece of bobbinet is then rolled on the drum. (Fig. 1.) This should be large enough to overlap the ends and sides of the drum. Another coat of rubber cement is then applied which should be sufficient to saturate the bobbinet thoroughly. The ends and sides are pasted down and the drum is ready for heat sterilization. Drums have been autoclaved for forty minutes at 240 degrees of temperature and 20 pounds of pressure without destroying their effectiveness. Adhesive qualities of the sterilized drums are tested with the surgeons glove; if it is a little dry the drum is repainted with a thin solution of the particular cement in use and its solvent. If sterilized in a steam sterilizer the drum should be placed above the bubbling water or some of the rubber will wash off.

A pattern is then made of the recipient area with a piece of cloth or cellophane, is marked and transferred to the area from which the graft is to be taken. The donor site is outlined with dye exactly after the pattern if the graft is to cover an area from which granulations were removed and a

* This method was presented to the Clinical Society of the N.Y. Polyclinic Medical School and Hospital on April 3, 1944. A Kodochrome motion picture of an operation was shown using this method and patients were introduced on whom this method of skin grafting was used. It was presented also to the Staff Meeting of the Jersey City Medical Center on April 6, 1944. A Kodochrome motion picture of an operation using this method was shown, patients were introduced on whom this method of skin grafting was used and the mirror was demonstrated.

little smaller if the graft is to cover an area from which scar tissue was removed. Cross lines are made across the skin to be removed following the marks previously made on the pattern. The skin is then superficially incised with a scalpel along the line of the borders of the graft. This causes a slight amount of gapping and permits accurate cutting of a pattern graft. The area within the incised line is cleansed with ether and painted with rubber cement; the area outside of the incised line is powdered with talcum, sulfadiazine, etc., to prevent the rubber on the dermatome from sticking to the skin. The skin around the recipient area is painted with rubber cement.

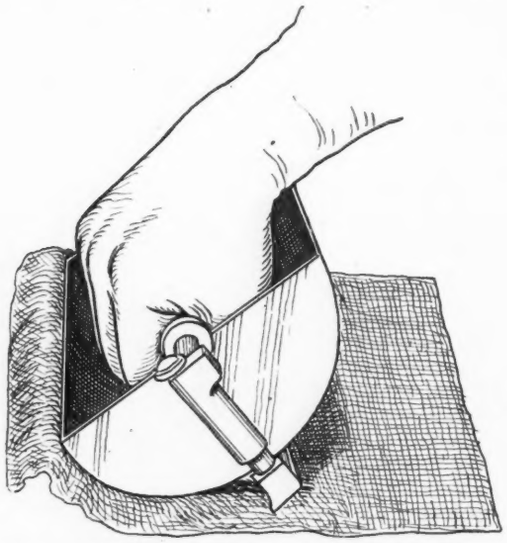


Fig. 1. Method of applying bobbinet to the drum. The convex surface, sides, and inner surfaces of the ends are painted with rubber cement. The bobbinet is then rolled on the convex surface and pasted to the sides and inner surfaces of the ends.

The knife blade is then set in the usual manner; the surface of the bobbinet is zero. After attaching the mirror the instrument is ready for use. The drum is pressed on the cemented skin and the graft is cut in the usual manner. (Fig. 2.) After cutting, the ends of the bobbinet are loosened and clamps are applied. Powder is then applied to the rubberized surface next to the drum if no further use of this surface is contemplated (patching); otherwise the gloves must be removed because the sheet will stick to the gloves. This does not interfere with sterility of the graft because the hands do not touch it. By gentle traction the fabric with adherent skin is pulled off the drum.

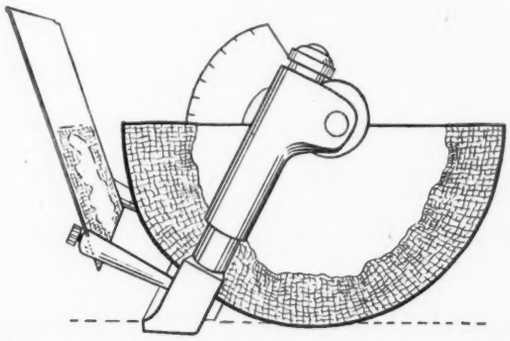


Fig. 2. Prepared drum with mirror. In this case the mirror posts are attached to the knife-holding portion.

Graft and recipient areas are treated according to the plasma fixation technic of Sano. If Tyrode solution is not available, we use normal saline in its place. For convenience at times we have used a prepared thrombin preparation with equally good results.

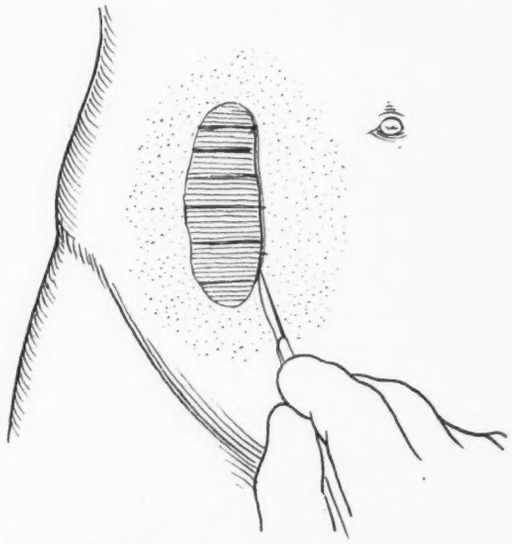
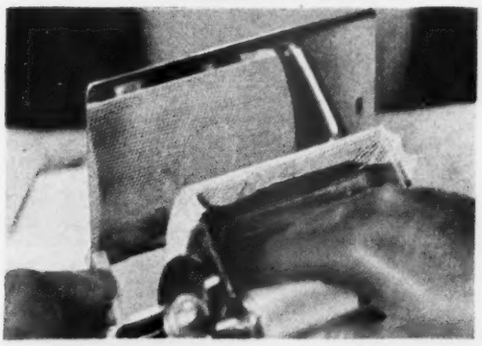


Fig. 3. Lightly incising through the outline of the area to be grafted by means of scalpel.

When applying the graft to the recipient area the assistant holds one end of the rubberized fabric up and the operator

A



B

C

D

E

PLATE 1

Contracted scar of the lower eyelid, nose and cheek. A, injection of novocatin into the scarred area. No harmful effects are produced by local anesthesia in skin grafting. B, reflection of bobbinet and graft in the mirror during the process of cutting. Mirror posts are attached to sections of the blade clip. C, graft and bobbinet held above the recipient area. D, graft pasted to the recipient area. Stitches have been placed along the lid margin through the bobbinet. E, unrefined final result.

PLATE 2

Third degree burns of the abdomen, genitalia and thighs. A, extent of the granulating area. B, cauterization of a section of granulations with a silver nitrate stick. C, removal of granulations in sheets from their base by means of a scalpel. D, prepared base with some strips of skin in place. Bobbinet can be seen on the strips. E, early final result. The area between the grafted sections of skin is covered with epithelium. No sutures were used.

A

B

C

D

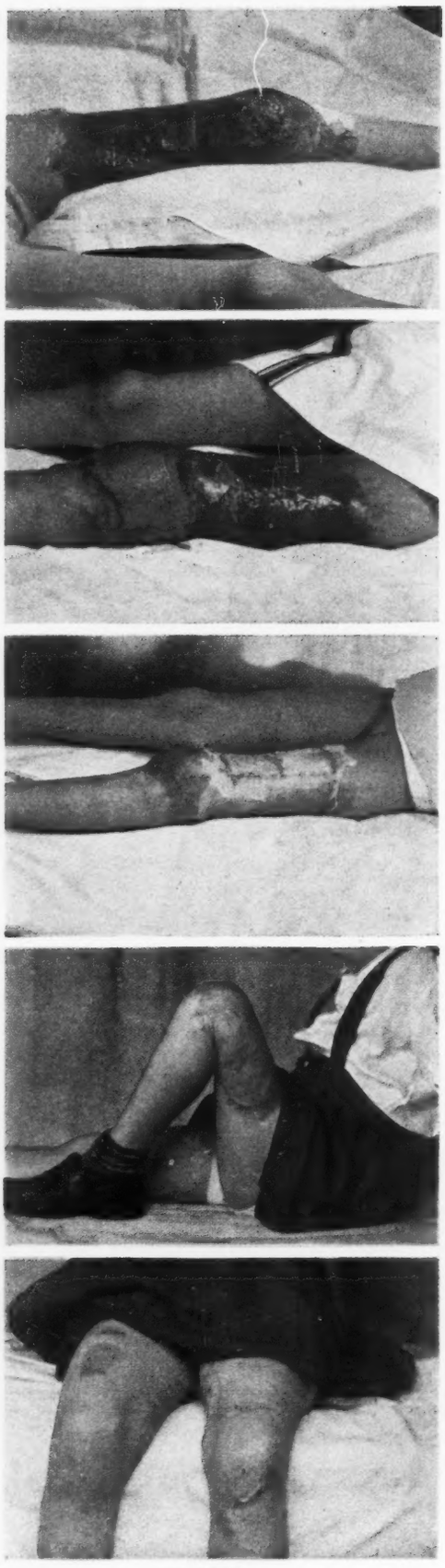
E

PLATE 1

PLATE 2

PLATE 3

Avulsion of the superficial tissues of the thigh. The muscles of the thigh were exposed. A, inner view of the thigh and extent of the granulations. B, outer view of the thigh and extent of the granulations. The successful graft over the knee is seen through bobbinet which is almost invisible because mineral oil has been applied over it. A small section of overlap with sutures is seen along the lower border. The white area above the graft is the remnant of a graft taken from the mother; the portion of the mother's skin over the knee was removed for autogenous grafting. C, graft applied to the lateral aspect of the thigh. Mineral oil has not been applied over the bobbinet so it appears very white. D and E, unrefined final result.



A

B

C

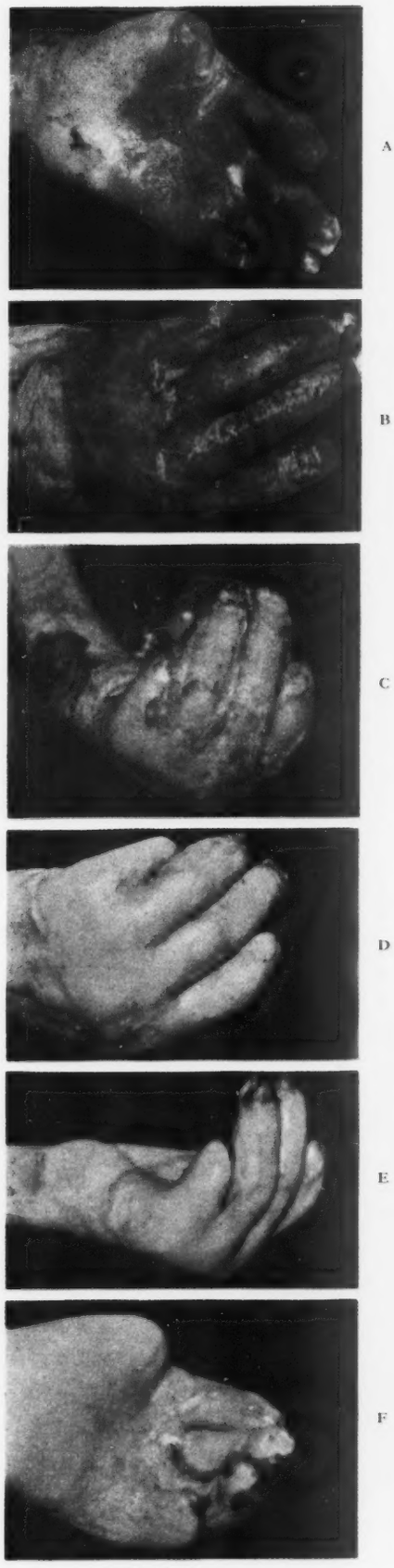
D

E

PLATE 3

PLATE 4

Third degree burns of the hand. A and B, extent of the granulating area. C, the graft on the fingers seen through the bobbinet. D, E and F, hand immediately after removal of the bobbinet from the fingers (second stage). No sutures were used.



A

B

C

D

E

F

PLATE 4

guides the graft to its ultimate location. When this is accurately placed, the operator presses the far end down and the assistant presses the fabric on the rubberized skin around the recipient area where it adheres. The assistant then holds up the fabric and the operator, using both hands, rolls it in place, sighting along the undersurface of the graft. As he rolls it down he presses the rubberized fabric to the prepared skin. In this manner accurate approximation of the graft to the recipient area is insured.

If the recipient area is uneven, as in a graft of the forehead, eyelids, nose and cheek, or uneven and depressed as in the repair of a Dupytrens contracture, the assistant follows the operator down, applying damp cotton wadding on the rubberized fabric to hold the graft to the irregularities and eliminate air pockets. In such cases the skin edges are inspected without removing the wadding from the broad surface of the graft, sutures are placed if needed or fabric adjustments made and a pressure bandage is applied. If the edges need adjustment, the fabric is pulled off the skin in the area, adjustments are made and the fabric is replaced.

Dr. J. Eastman Sheehan and Dr. Lawrence Gatewood have aided the author in a study of cases in which this method was used. We have concluded that pressure bandages over the graft and immobilization of the part are essential for the best results. This insures perfect apposition of the graft to the recipient area and also prevents air pockets and oozing. Good results have been obtained on even surfaces with no dressings at all over the fabric, but we have noted that bleb formation is more common whenever pressure bandages are not used. In general the type of dressing used and the time of the first dressing is determined by the character of the base and the site of the graft. If the base is smooth, and satisfactory bandaging is difficult, we immobilize the part in traction and do not use any bandages over the bobbinet. An example of this would be a large sheet of graft over the inner aspect of the thigh. The danger of wrinkling with the loss of a large part of the graft

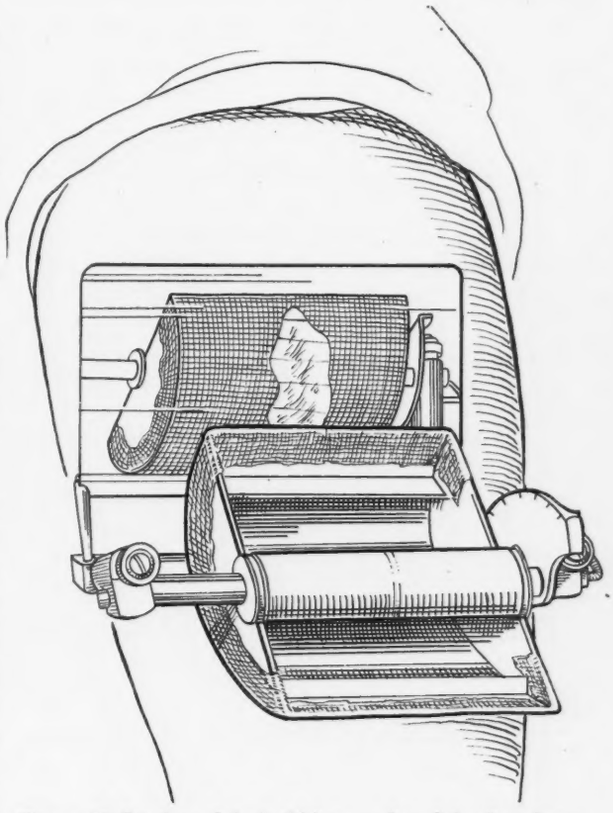


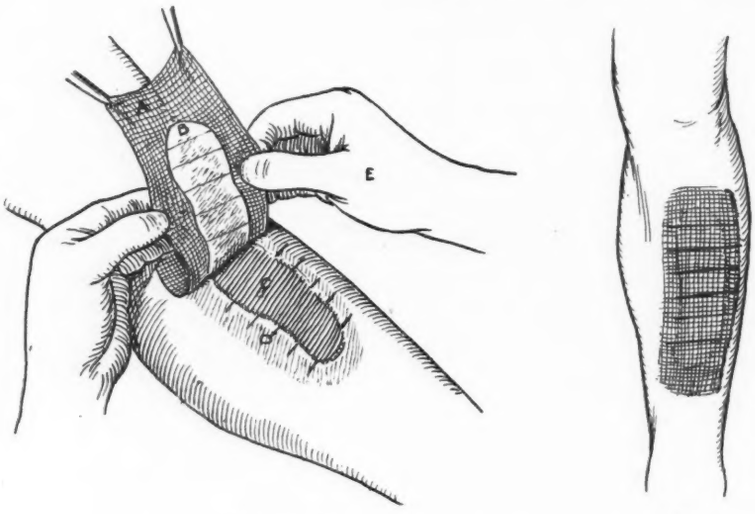
Fig. 4. Reflection of the bobbinet and graft in the mirror.

is great in this region so we immobilize the part in a Thomas splint with traction, and no bandages are placed over the bobbinet. Otherwise we usually use strip grafts in this region with pressure bandages. In the latter case wrinkling of one strip will not affect other strips. If pressure bandages are applied, they are changed in five days and replaced for a few more days if the case warrants it. If there is much overlap of the edges, the rubberized fabric is removed from the overlapped sections and the skin is allowed to dry up.

Dressings above the bobbinet and the bobbinet itself are easily removed. In order to leave the bobbinet in place the top layers of the dressing are picked off and the layers next to the bobbinet are saturated with ether or the particular solvent used for the rubber cement. The bandages can then be picked off the

rubberized bobbinet. If the bobbinet is to be removed, the solvent is poured over it and it is picked off without adhering to the graft.

Granulations are cauterized freely with silver nitrate sticks and removed in a sheet from their base by stripping them off with a scalpel. This not only insures a sterile



A B

FIG. 5. A, method of applying the graft. *A*, rubberized bobbinet; *B*, graft adhering to the rubberized bobbinet; *C*, recipient area; *D*, rubberized skin around the recipient area; *E*, position of the hands when applying the graft to the recipient area. B, graft in place. The rubberized bobbinet is pasted to the rubberized skin around the recipient area.

At times it is advisable to continue immobilization for a longer period and also protect the part for a longer time as in treating children. In these cases the bandages are re-applied. As the fabric is separated from the graft with the bandages practically untouched, the bandages are in the form of a mold of the part. When replaced they fit the area perfectly.

When covering large granulating areas we use strip grafts. The sheet of fabric and skin is held at each end with clamps and narrow strips are cut. These are then laid across the prepared base and pasted to the skin around the area. Excess pieces are cut off (overlap), layed end to end, and pasted together with strips of prepared bobbinet to make another strip. In this way no skin is lost. The skin around the recipient area is painted with rubber cement.

When dealing with irregular areas, the sheet of skin and fabric is cut in any desired pattern and pasted on as described when strip grafting.

base but also removes excess tissue which is not needed for skin growth and will only result in scar tissue later. Wet saline packs are applied to the denuded area and oozing stops in a few minutes.

Drainage slits are never made. Grafts are applied only on a perfectly dry base and we expect growth in every part of the graft, therefore making slits over possible sites of trouble would be a blind procedure.

Choice of Fabric. We tried various fabrics including different weaves of women's stockings but found that fine cotton bobbinet was the best material available to us. It has a very fine thread, stretches in all directions and will follow any contour very easily. A fine silk or possibly a fine nylon mesh would be better. Fabrics made of rayon are unsuitable because rayon disintegrates in the high temperatures of the autoclave if left in for the usual period of sterilization.

Adhesive. Only different brands of nonvulcanizing rubber cement have been used and all with success. However, the dis-

advantage with some brands is that they are highly pigmented, the edges of the wound cannot be easily seen and adjustments are difficult to make. Any of the light colored cements are satisfactory.

Mirror. The mirrors are cut from large metal mirrors such as are used by photographers. They measure about 7 inches by 3½ inches and are supported by mirror posts of which we have made two types: The first type is screwed into the center of the flat surface of the knife holding portion of the dermatome above the blade rest and projects at right angles to it. The second type of posts is attached to the centers of two one-inch sections which are cut off the knife clip, and project outward at an angle of 10 degrees to the skin surface. The first type of posts is about 1¾ inches long, the second type is about 1¼ inches long. Slots are cut in the mirror ends of the posts so that the mirror is set at about 45 degrees to the skin surface. The mirrors are held in place with thumb screws which are placed in the ends of the mirror posts. Posts are elevated to prevent dragging on the cut surface of the skin.

ADVANTAGES OF THE BOBBINET

1. The graft adheres to the rubberized bobbinet because it presents a comparatively rough surface.

2. The graft can be easily handled and can be easily placed on the recipient area. Thin grafts are not mutilated.

3. The graft can be cut into any shape to cover accurately the areas to be grafted. The pieces are pasted on.

4. The graft can be easily applied to areas which are surrounded with scar tissue which would make suturing impossible.

5. The graft is placed on the recipient area in the same condition it was removed from the donor area. Contraction of the graft can be easily overcome by merely stretching the rubberized fabric.

6. Widely expanded raw areas resulting from excision of scars in normal skin can be made smaller by "tucking in" the skin as the graft is pasted on.

7. The graft can be made to conform to any elevation or depression; it can be moulded over forms to line cavities as in buccal inlays or line the ends of tubes when this is necessary.

8. Only a minimum of skin is lost because the amount of skin excised is patterned after the area to be covered.

9. Free sheets of rubberized bobbinet can be made prior to operation and used for patching.

ADVANTAGES OF THE MIRROR

1. The operator is in a comfortable position.

2. Reflected light from the mirror gives complete illumination to the graft.

3. The graft is in full view of the operator at all times.

4. The operator can see exactly the operation of the knife at the commencement of the excision.

5. The drum during its manipulation over the surface does not interfere with the operator's vision and adjustments for thicker or thinner cuts can be made.

6. The proper cutting angle is fixed if the operator holds his head in a steady position; if the cutting edge is seen, the angle is correct; if it moves up or down, it is incorrect.

7. Lateral motion is possible while viewing the operation through the mirror. If the blade is cutting into adjacent tissues, this can be seen immediately and can be corrected by lateral tilting of the drum of the dermatome.

8. Variations in the thickness of the graft can be made by viewing the cut in the mirror. Cross lines made on the skin prior to cutting can be seen through the split skin. Tapping the thickness gauge at predetermined points allows thick and thin sections to be cut on the same piece of skin.

9. By using the mirror, the operator can stand far enough away to get a comprehensive view of the graft while cutting.

ADMINISTRATION OF INTRAVENOUS FLUIDS TO SURGICAL PATIENTS*

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INTRAVENOUS fluids are used frequently in surgical practice. The intravenous route has, on the basis of merit, almost entirely replaced the other parenteral methods of administering fluids except in unusual situations.

It seems worth-while to discuss some of the commonly used fluids that are given by vein to surgical patients, and emphasize certain principles governing their administration. An attempt will be made to embody in one article certain facts which may be of some value as a guide to intravenous therapy. Less commonly used fluids are also mentioned because they will undoubtedly be used to a greater extent in the future.

It is well to bear in mind that a large number of surgical patients require intravenous fluids for only a few days. These patients quickly regain their normal physiologic status after they begin to eat and drink. However, seriously ill patients who for one reason or another cannot take food or water by mouth offer a real problem to the surgeon as they must be maintained parenterally (usually intravenously) for a variable number of days. It is these patients who require an understanding on the part of the surgeon of the principles of proper fluid therapy, and at times the outcome in a severe surgical illness depends upon the efficacy of this therapy.

The substances themselves to be described from the standpoint of intravenous administration are water, salt, dextrose, blood, plasma, amino acids, gelatin, pectin, and miscellaneous fluids.

WATER

Coller and Maddock[1–5] have made intensive and valuable studies of the water requirements in surgical patients. They have estimated the water loss in sick surgical patients and have found that 1,000 cc. to 1,500 cc. was the average daily amount required for water of vaporization. This water of vaporization is lost by way of skin and lungs and is part of the heat dissipating mechanism of the body. Under unusual conditions such as high fever, excessive sweating, hot humid weather and hyperthyroidism, this loss may be increased to 2,000 cc. or more each day. After the heat dissipating mechanism (or water for vaporization) is supplied the remainder of the available water is utilized for urine output. A satisfactory urine output depends upon several factors. It has been demonstrated[6] that approximately 500 cc. of urine is the minimum daily amount required to excrete 35 Gm. of waste material (an average daily amount). To do this the normal kidneys must function at a maximum concentrating power (shown by a high specific gravity). With the volume of urine less than 500 cc., retention of waste material, manifested in the blood by an increased non-protein nitrogen, will occur. If the kidneys are diseased and cannot concentrate normally, more water is needed. Thus with a concentrating ability that is down to 1.010 about 1,500 cc. of urine is needed to get rid of the 35 Gm. of waste material.

For the average surgical patient 1,000 cc. is a good daily urine volume with a specific gravity in the middle range. For seriously

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ill patients, perhaps a larger output is desirable, although there is some objection to a large fluid intake especially in the thyrotoxic patient.[7]

Certain recommendations have been made by Coller and Maddock which are adequate in most cases, but can be varied to suit individual requirements. For uncomplicated cases 2,000 cc. to 2,500 cc. of water daily (1,000 cc. to be water for urine) is sufficient. For complicated cases 3,000 cc. to 3,500 cc. daily (1,000 to 1,500 cc. to be water for urine) will be required.

In our own practice we have found the urinary output to be a satisfactory index of water balance in most instances. In general the plan suggested by Coller and Maddock has been followed. It should be noted, however, that old people who are poor surgical risks do not handle large amounts of intravenous fluids well. This is because the fluid lost by vaporization is so variable that the urine loss is not always a safe guide. In these doubtful cases Wangensteen[8] has used the bedside weighing plan. If a patient has a low urinary output, daily weighing will determine whether administered water has been retained in the body or lost through vaporization.

Drew[9] and others suggest measuring the state of hydration by using the hematocrit determination of venous blood, the specific gravity of blood, the specific gravity of plasma, and the protein concentration of the plasma as calculated from the plasma specific gravity. The frequent performance of these tests would probably be the safest and best index of satisfactory water balance.

SALT

The average daily salt requirement is 5 to 10 Gm.[10] If the intake is greater than the requirement, most of the excess is excreted in the urine. In health this is easily done but in a sick, surgical patient an excessive intake of salt may produce edema[5] as the kidneys cannot excrete the excess as they do in health. In combination with hypoproteinemia, excessive salt produces edema even more quickly. It is inadvisable to give more than one liter of normal saline solution daily (8.5 Gm. salt) to a patient unless there are abnormal salt losses.

Abnormal salt losses occur through excessive perspiration, continuous gastroduodenal suction, vomiting, diarrhea, intestinal or biliary fistulas, or in any other condition in which bodily fluids are lost. These losses must be measured whenever possible and as they contain a fairly consistent amount of salt per liter, correction must be made in the daily calculation for fluid requirement.[5] As none of these fluids (which are abnormally lost) contain more than 5 or 6 Gm. of salt per liter, they may be satisfactorily replaced with normal saline solution, volume for volume. Thus if a patient loses 1,000 cc. of fluid through gastroduodenal suction daily, the replacement necessary would be 1,000 cc. of normal saline solution. This would be in addition to the liter given to satisfy body requirements, making 2,000 cc. of saline necessary. If still more fluid is required (as estimated according to the requirements described under water), it would be supplied by dextrose in distilled water or by amino acid solution.

The plasma chloride level is normally 560 mg. per 100 cc. If the chlorides are depleted to 450 mg., symptoms usually appear. These are noted as depression, fatigue, nausea, and, if the chloride level continues to drop, stupor may occur. To correct the salt deficiency as estimated by the plasma chloride level Bartlett[10] recommended giving 0.5 Gm. of salt per kg. of body weight for each 100 mg. of plasma chloride loss.

Thus if a patient weighed 50 kg. and the plasma chlorides were found to be 460 mg., the amount of salt would be calculated as 0.5 Gm. (salt) $\times$ 50 (kg.) $\times$ 1 = 25 Gm. salt needed to bring the level to 560 mg.

Daily plasma chloride determinations may be made on patients who have low

chlorides, or the urinary chloride may be estimated. If there is more than 1 Gm. of salt in the daily urine, great salt loss will not occur. If the plasma chlorides cannot be raised to normal by Bartlett's formula no more should be given as edema will occur.

When the patient recovers sufficiently to begin eating, the chlorides usually return quickly to normal. In the presence of hypoproteinemia, salt administration according to the formula given may produce edema. In these cases the plasma chloride levels may be normal or below normal. The plasma chloride level is, therefore, no measure of salt retention but should be a useful guide in salt loss. Retention of salt from excessive administration will cause hydremia rather than hyperchloremia.

The indications for Ringer's solution are approximately the same as those for normal saline solution. Ringer's solution contains less sodium chloride (0.6 per cent) and has small amounts of potassium chloride (0.004 per cent), calcium chloride (0.002 per cent) and magnesium chloride (0.002 per cent). It has been stated to be of value when fixed bases are lost.[18]

Ringer's lactate solution (Hartman's) is essentially the same solution as Ringer's, with the addition of sodium lactate (0.3 per cent), and it is used in similar situations.

GLUCOSE

Glucose solutions are valuable in the prevention of ketosis, in protecting the liver, and supplying water and food. A 5 per cent solution in distilled water is isotonic, a 10 per cent solution is perhaps best given to patients with liver damage, hyperthyroidism, or malnutrition. If a given patient requires 3,000 cc. of intravenous fluid a day and there have been no abnormal salt losses, 1,000 cc. would be given as normal saline solution and the remainder as 5 per cent glucose in distilled water or perhaps 5 per cent glucose with amino acid solution.

Winslow[11] showed that 98 per cent of 5 per cent glucose solution in distilled water was retained when 3,000 cc. was administered daily at the rate of 300 to 500 cc. per hour. The same amount of 10 per cent glucose given at the same rate was 95 per cent retained.

BLOOD

The value of blood transfusion, especially to correct loss of blood, has been well established. In serious injuries with marked blood loss, and in operative procedures in which blood loss is expected to be extensive, transfusions of whole blood are demanded. The administration of whole blood before and during serious operative procedures is now a common practice and certainly has been of great benefit to many patients both in the prevention of postoperative shock and in aiding convalescence. Shock due to blood loss should be treated by blood transfusion, if blood is available. If not available, plasma is an effective substitute. Shock due to burns, or to an injury not associated with blood loss, is perhaps better treated with plasma, as the colloidal osmotic pressure of plasma is twice that of an equal volume of whole blood. Probably the best guide as to the need for whole blood is the extent of the patient's anemia.

The indirect method is the one most frequently used at the present time. Its advantages are quite obvious especially since citrated blood may be stored for a few days before use. Sodium citrate has been shown to produce toxic reactions if given rapidly in large amounts.[12] The usual amount used as an anti-coagulant is 10 cc. of 2 to 4 per cent sodium citrate solution to 100 cc. of blood. Heparin may be used as an anti-coagulant if desired. Glucose may be added to the citrated blood allowing it to be stored for longer periods as it decreases the tendency toward hemolysis.

In the blood bank maintained at our hospital whole blood is stored for a maximum period of seven days, after which it is centrifuged to obtain plasma. Sodium

citrate (4 per cent) is used as the anticoagulant. The blood is stored at approximately 4°c. It is checked for hemolysis before use and is usually given to the patient directly after removal from the refrigerator.

Reactions from blood transfusion are at times a source of grave concern. They are usually due to pyrogenic substances in the apparatus used. Meticulous cleansing of the tubing, connections, and needles immediately after use, preferably by the same individual is helpful in avoiding these pyrogenic reactions. Routine typing, careful cross matching and Wassermann or Kahn tests are, of course, essential prerequisites to any transfusion of whole blood.

Some of the previously unexplained reactions have been found to be due to the existence of the Rh factor.[13,14,15] These reactions are of interest to surgeons when a patient requires repeated transfusions. The Rh factor is present in the blood of 85 per cent of all people. These are Rh positive. The 15 per cent who have no Rh factor are called Rh negative. If the recipient is Rh negative and is given repeated transfusions of Rh positive blood, he will develop anti-Rh agglutinins in his blood. After several transfusions, a reaction may occur. It is for this reason that the military services determine the Rh factor of patients requiring repeated transfusions, as these reactions may be severe and serious.

PLASMA

Plasma is ordinarily prepared by removing the cellular element from citrated whole blood. It may also be prepared from blood in which heparin has been used as the anticoagulant. Serum is quite similar to plasma except that it is taken from whole blood which has been allowed to clot. After the clear liquid has separated from the clot it is aspirated. Serum thus contains no fibrinogen.

The value of plasma is unquestioned in many surgical conditions. Severe burns, shock without hemorrhage, shock with hemorrhage (when whole blood is not available), hypoproteinemia (particularly acute) are all instances in which plasma is indicated. The hemoconcentration offers a good index as to the amount of plasma needed in burns and shock without hemorrhage. The elevation of lowered plasma protein levels is somewhat difficult to accomplish as Scudder[16] and Mahoney[17] have pointed out. Large amounts of plasma must be given. Perhaps some of this protein is immediately taken up by the tissues which need it and thus the plasma protein level does not rise until the tissue needs (due to depleted tissue protein) are satisfied. However, with intravenous plasma, the protein level can be maintained above the so-called "critical point" (5.2 Gm.) until the patient can take food.

The advantages of plasma are such that it is a substance of great usefulness. It may be dried or frozen and stored safely for a long time. Pooled plasma may be used as a source of supply. Concentrated plasma (four to six times) may be used for the treatment of cerebral edema.[18] Reactions are few and are less common after the use of pooled plasma.

The disadvantages that may be attributed to plasma are that one donor is necessary to obtain 250 cc., that very large amounts are necessary in certain conditions, and that it is expensive.

Elman and Lischer[20] studied experimentally the use of amino acids, serum, and plasma in the therapy of fatal shock due to repeated hemorrhage in unanesthetized dogs. Replacement of blood loss by the various substances showed differences in the survival time. It was unchanged with glucose in saline, increased to 4.2 hours with amino acids and to 4.5 and 4.6 hours, respectively, with citrated plasma and serum. With heparinized plasma, the survival time was six hours. Fall in blood pressure was greater with citrated plasma and serum than with heparinized plasma. This seems to imply that heparinized plasma is of very definite

value in the treatment of shock due to hemorrhage.

AMINO ACIDS

The intravenous use of amino acids in the prophylaxis and treatment of hypoproteinemia in surgical patients is a procedure of great value. For many years the water, salt, and glucose requirements of patients were carefully watched but only recently has the protein requirement and the occurrence of hypoproteinemia aroused special interest.

The excellent contributions of Elman[20–27] on this subject, particularly with reference to the surgical patient, are deserving of thorough study. Other contributors[28–31] have made valuable additions, and their work, together with that of Elman, is the basis for most of the knowledge which may be applied to the problem of hypoproteinemia in surgical practice.

The amino acid solution is prepared from the digestion of casein by pork pancreas. It is carefully sterilized according to definite specifications and is given commonly as a 5 per cent solution (of amino acids with 5 per cent dextrose solution although it may be administered in other concentrations. This preparation may be obtained in liter flasks ready for use, each liter containing 500 cc. of 5 per cent solution of amino acids (amigen) and 500 cc. of 5 per cent dextrose solution. All the essential amino acids are contained in this solution, as determined by growth tests in animals. The preparation is much less expensive than plasma and for correcting hypoproteinemia is an efficient substitute. Reactions to the intravenous administration are very few and not serious. Flushing, a feeling of warmth and nausea, are the usual reactions and disappear when the rate of flow is reduced. Some instances of phlebitis have been reported after repeated use. The fact that the protein is in the form of amino acid is important as this is the form in which normally digested protein enters the blood stream. The liver is probably spared in this way because there is no necessity of breaking down proteins to amino acids. It should be pointed out, however, that about one-third of the protein in the solution is in the form of dipeptides. This is of no practical significance.

The necessary amount may be varied to suit individual needs. Usually 1 Gm. of protein per kg. of body weight is the basis for calculation of nitrogen requirement. Amino acid solution will maintain nitrogen balance, will correct hypoproteinemia and will produce elevation of the albumin fraction if given in sufficient quantity. Most fasting patients excrete from 4 to 5 Gm. nitrogen a day when sufficient glucose is given to meet caloric needs. Some excrete much more which is supposed to indicate a toxic destruction of body protein. This loss may be prevented by furnishing extrinsic protein in the form of amino acids. Adequate amounts of glucose must also be given with amino acids to furnish energy, otherwise the proteins will be drawn upon for this purpose and will not be available for the correction of the tissue protein loss and the hypoproteinemia.

The rate of administration varies with the individual patient. Usually the 5 per cent solution may be given at the rate of 300 to 500 cc. per hour. If warmth or flushing occurs, the rate may be easily decreased.

The fact that amino acid solution can produce elevation of the plasma albumin is of tremendous significance. The albumin fraction is the one most affected in surgical conditions.[27] This fraction contributes 85 per cent of the colloidal osmotic pressure of the plasma. It is also present in twice the concentration of globulin in normal plasma. For every Gm. of plasma albumin lost or gained approximately 30 Gm. of tissue protein is lost or gained. Thus, if amino acid therapy makes possible the control of this factor the many complications due to hypoproteinemia should be, at least, partially preventable.

The clinical manifestations of hypoproteinemia as given by Elman[27] are serious and important. Surgical shock, suppression of urine, hemoconcentration, abdominal distention, edema, ascites, and faulty wound healing may all be due to this condition. In view of these clinical evidences the importance of an adequate protein intake needs hardly to be re-emphasized.

Our personal experience with amino acid solution (amigen) has been limited, but a satisfactory and sometimes striking clinical improvement has been noted after its administration to seriously ill patients. Plasma protein levels were maintained at or near the normal values.

Severe hepatic insufficiency probably contraindicates the use of amino acid solution, although it has been used where liver damage was evident with no untoward effect. Otherwise there are apparently no contraindications.

GELATIN

Because of the difficulties encountered in obtaining and processing blood and plasma, as well as the expense, search is constantly in progress for an effective blood or blood plasma substitute.

Gelatin has been investigated from this standpoint. Hogan[32] was the first to use it intravenously in 1915 but since then, interest in gelatin as a blood substitute was lacking until fairly recently. Parkins[33] and others studied its value as a plasma substitute in experimental hemorrhage and burn shock in dogs. As the composition of gelatin solution varies with the source and method of preparation, it is necessary to describe each solution used. Parkins used a 6 per cent solution in 0.85 per cent saline. Repeated infusions caused no toxic reactions and superiority over normal saline infusions in the management of experimental hemorrhage was definite. It caused more marked hemodilution than plasma with uniform volume replacement. Their experiments indicated that gelatin was a suitable substitute for plasma in experimental hemorrhage. In experimental burns gelatin compensated for loss of plasma and correction of hemoconcentration as well as plasma did. The survival time was greater, however, in the animals treated with plasma. The conclusion was reached that if a factor can be identified in plasma which accounts for its ability to maintain blood pressure in the severely burned animal during the secondary phase of so-called acute toxemia, the addition of this factor to gelatin would probably result in a more adequate plasma substitute for burns.

Brunschwig, Corbin and Johnston[34] investigated gelatin from the standpoint of nutritive value, tolerance by man and ability of the body to metabolize it. They state that gelatin is an incomplete protein and that all essential amino acids are not present. It may serve as a source of nitrogen but is not adequate. Their patients tolerated intravenous infusions well, and at least part of the gelatin was catabolized. Gelatins vary widely in character depending upon the source and methods of manufacture.

PECTIN

Another material which has been considered as a possible substitute for blood or plasma is pectin solution. Hartman and others[35,37] have shown that it is non-antigenic and non-toxic. A 0.5 per cent solution has about the same viscosity and osmotic pressure as whole blood. It is easily obtainable, (from citrus fruits) and readily prepared. It is sterilized by heat, should be neutralized and have electrolytes added. It should also be tested for viscosity, hemolysis of red cells, sedimentation of red cells and precipitation of fibrin before being used clinically. Temporary retention in the blood and liver may occur but excretion of unchanged material in the urine is rapid.

Pectin solutions produce a marked and sustained rise in the plasma volume of normal individuals.[36] The degree of increase corresponds to the amount injected and

persists from four to twenty-four hours after the infusion is completed. Saline solutions produce a much less striking rise. Hartman[37] states that the label on the flask containing the pectin solution should indicate the physical characteristics and the method of preparation and sterilization. Precipitation of prepared pectin solutions to form a fine light powder which may be readily redissolved in sterile water, isotonic saline, or dextrose solution has been accomplished. Increased sedimentation rate occurred in patients given pectin intravenously. Coagulation time remained normal and bleeding time was shortened. Results in 125 clinical cases[37] showed sixty-eight good results, twenty-seven fair and five poor results. Clinical improvement and maintenance of blood pressure were used as criteria.

Good pectin solutions are clear, have a viscosity of 2 to 4 at 38°c., and an osmotic pressure of 45 to 70 mm. Hg., depending upon whether 0.75 or 1.5 per cent solution is used. The molecular weight varies from 60,000 to 75,000. The solutions are prepared by multiple filtration and heating for from fifteen to eighteen hours.

Meyer[38] and others used pectin in treating sixty patients in shock. They demonstrated its effectiveness and observed marked hemodilution after its use. No undesirable side effects occurred, except increased sedimentation rate and this was not considered troublesome.

MISCELLANEOUS SUBSTANCES

Certain other fluids have from time to time been tried and found impractical because of limited availability or uncertain properties.[18]

These are bovine plasma, bovine albumin, isinglass, crystallin hemoglobin, human ascitic fluid, cadaver blood and placental blood.

Gum acacia solutions, which were formerly used a good deal, are objectionable because of frequent reactions, distortion of the blood count for long periods, deposition of the acacia in the liver, and incompatibility with citrated blood.

COMMENT

This article embraces a wide subject matter. Bringing together in one article a description of the various commonly used intravenous fluids may prove of value to the surgeon in his daily work.

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VASELINE GAUZE CONTACT FIXATION OF SPLIT THICKNESS (PADGETT) SKIN GRAFTS*

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THE purpose of this paper is to discuss the use of split thickness skin grafts obtained with the Padgett dermatome for covering large granulating areas secondary to severe burns and the use of a method of application of such grafts which has proved successful in our hands. We refer to this method as vaseline gauze contact fixation of split thickness (Padgett) skin grafts. This has proved to be the simplest method which we have used in covering large areas of granulating tissue and in cutting such grafts to a fixed pattern. It will further be our purpose to discourage the use of pinch grafts in covering the large granulating areas.

During the past twenty-two years many types of skin grafts have been used at the North Carolina Orthopedic Hospital to cover defects in the dermis due to such conditions as congenital defects, mechanical and chemical trauma and burns. More than five hundred patients have been grafted during the past two or more decades, many of the patients requiring numerous skin graft operations. Previous to the advent of the Padgett dermatome,[1] the Gillis tube, the pedicle graft, the pinch graft, and the full thickness skin graft were used almost with equal frequency. The results were good functionally but too often the cosmetic end result was not desirable. We found the poorest cosmetic results were obtained by use of the pinch graft, as the healed grafted area contracted sharply and had a pebbled appearance. (Fig. 1.) Of course, concomitant with the pebbled recipient area always was found the spotted, scarred donor region. The better cosmetic results were obtained by means of the pedicle and free skin grafts as well as with the Gillis tube. For the rebuilding of destroyed skin organs, the pedicle skin flap and Gillis tube grafts are undoubtedly far superior to any other type of graft. The tube graft supplies required thickness for filling concavities, and for rebuilding a part which requires two soft, pliable, epithelial surfaces and some thickness it has no equal. However, when large granulating areas or large open wounds with sufficient physiologic base are to be covered, we believe the tube graft is not indicated, as it results in too bulky a graft when only a thin dermal covering is necessary.

With the introduction of the Padgett dermatome it was found that a free skin graft of uniform thickness could easily be obtained, and large areas could be grafted in a short time. However, the problem of fixation of the graft to the donor area remained as a tedious job, requiring the suturing of the graft either to the healthy skin surrounding the recipient area, or suture of the graft to a carrying vehicle such as *gutta percha* or cellophane. Such suturing required a good bit of time especially if the graft was large or if the blanket graft of McPheeters and Nelson[2] was used to cover large areas. To overcome this problem we began using flamed adhesive strips of tape to hold the graft in place at the recipient area; the grafts and adhesive straps were then covered with vaseline gauze and pressure dressings. However, even this method, though more rapid than suturing and giving a satisfactory percentage of "take," was time consuming. The skin graft edges tended to curl under, and

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the graft would retract some because of its inherent elasticity.

Rank[2] has suggested placing the split thick graft on *tulle gras*, a composition of vaseline and balsa of peru on gauze, using this as a carrying vehicle for the graft; but he advocates suturing the carrying vehicle to the recipient area. However, he states that on occasion he has maintained the graft in position without suture fixation.

During the past months we have used the vaseline gauze contact fixation of split thickness grafts on twelve patients. This method is more rapid than any method we have used to date, and the percentage of "takes" has been consistently good.

METHOD

Sterile vaseline gauze strips are made up in the following sizes: 5 by 11½ inches and 10 by 23 inches, as well as the routine 3 by 10 inch size. If a large granulating area is to be covered, full drum grafts are obtained via the Padgett dermatome (full drum grafts measure 4½ by 10 inches). Hemostats are clipped onto the skin graft borders while the graft is still on the dermatome drum. During the above procedure the surgical nurse flattens out a 5½ by 11 inch sterile vaseline gauze on two unfolded sterile sponges which in turn have been placed side-by-side on a large sterile, towel-covered wood block. The skin graft is then taken off the dermatome drum using the hemostats as handles. The graft is next placed on the sterile vaseline gauze allowing a one-inch border of vaseline gauze around the graft, the *stratum corneum* layer being in contact with the vaseline gauze. The center portion of the skin graft is then gently pressed onto the vaseline gauze by means of a hemostat. Sulfathiazole powder is then sprinkled on the raw graft surface. All hemostats are then taken off one of the narrow skin graft ends, and a picture roller is guided across the graft under constant firm pressure. As the roller meets hemostats still clamped to the graft, the instruments are removed. (Fig. 2.) When the picture roller has reached the distal end of the graft, it is found that the skin graft adheres firmly under some tension to the vaseline gauze with no tendency for the skin edges to curl. (Fig. 3.) In the absence of a picture roller the graft can be easily pressed onto the vaseline gauze by Kelly clamps, care being taken not to allow the vaseline to get on the raw graft surface. The entire mass, i.e., skin graft, vaseline gauze and sponges, is then picked up manually and pressed in postion over the recipient area. (Fig. 4.) The sterile sponges are then easily removed from the vaseline gauze. Through the transparent vaseline gauze it is a simple matter to place the graft in exactly the desired position in regard to the recipient area, as the graft can be easily observed. (Fig. 4.) When the graft is in the correct location, the vaseline gauze is gently pressed onto the underlying skin graft, and the overlapping vaseline gauze borders adhere nicely to the healthy skin borders surrounding the recipient region; no sutures are used. Pressure dressings are then applied and held by stockinette

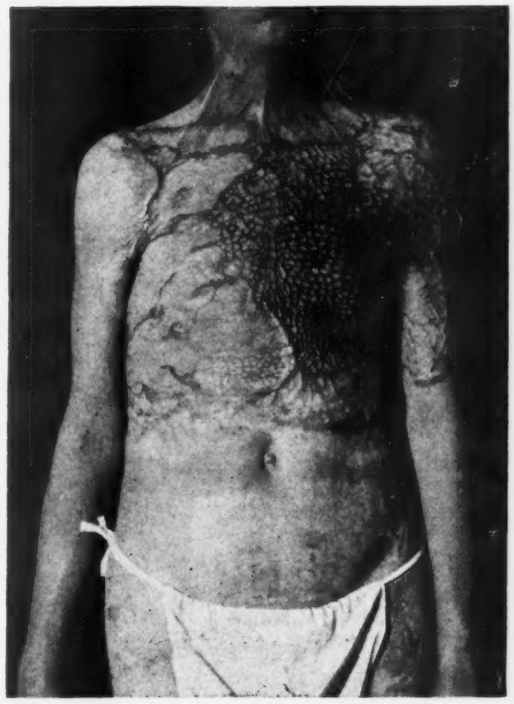

Fig. 1. Patient five years after skin grafting. Pinch grafts were used on left chest; Padgett grafts were used on right chest. Note poor cosmetic appearance of pinch grafted area.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 2. Graft removed from drum and placed on prepared vaseline gauze. The picture roller is then guided over the skin graft under constant firm pressure. Note sulfathiazole crystals on raw graft surface.

FIG. 3. The skin graft adheres to the vaseline gauze via the viscosity of the petroleum. Note no curling of graft edges and no loss of size of graft because of inherent elasticity.

FIG. 4. Skin graft and vaseline gauze are placed over the recipient area and pressed in place. No sutures are used. Note translucency of vaseline gauze allowing observation of underlying graft.

FIG. 5. Pattern graft being cut from original graft adhering to vaseline gauze.

FIG. 6. A and B, patient before skin grafting; burn injury.

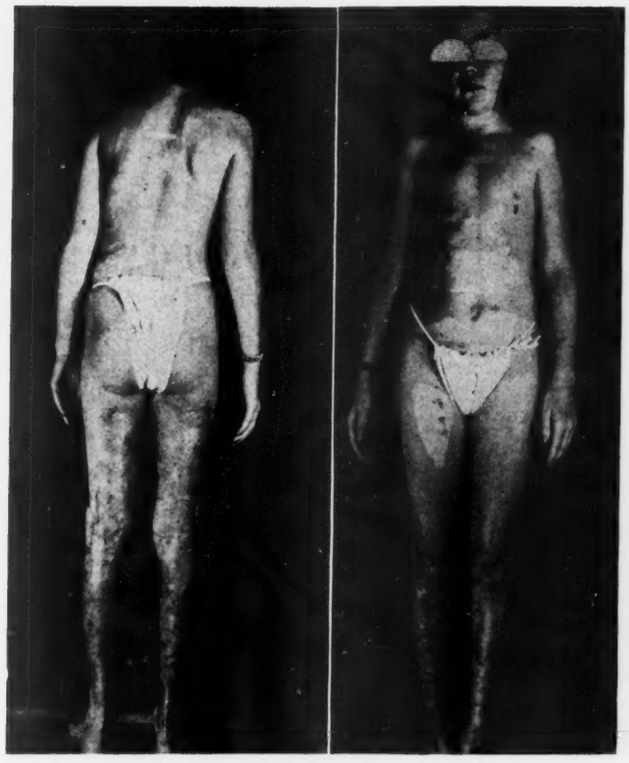

FIG. 6. C, patient four months after completion of skin grafting.

bandage. If after the vaseline gauze and graft are placed over the recipient area it is found that small parts of the graft edges overlap the healthy skin, these overlapping portions of the graft and vaseline gauze can be easily cut by scissors and used on other small granulating spots. Thus every bit of skin graft is used in the grafting operation.

If large areas are to be grafted, we use the large 10 by 23 inch vaseline gauze, and place two full Padgett drum grafts side-by-side on the vaseline gauze using the same method as described above. Here the entire patch graft can be moved easily by two persons to the recipient area and held in position via the viscosity of the vaseline.

FIG. 7. A, patient before skin grafting; burn injury. B, patient five months after completion of skin grafting. C, patient two years after skin grafting. Note blending of grafted skin and normal contour of leg. Knee function is normal.

Small pattern grafts can be cut by the dermatome and held to the recipient area by vaseline gauze cut on a pattern slightly larger than the pattern graft itself. If the surgeon does not wish to cut a pattern with the dermatome, it is a simple matter to cut a full drum graft, place the graft on vase-

line gauze and cut the pattern out of the gauze and adherent graft as easily as such a pattern can be cut out of paper. (Fig. 5.) The extra skin obtained after cutting the pattern can be used to cover any other defects or returned to the donor site.

The postoperative care is minimal on our skin graft areas. It is our opinion that the less the graft is disturbed by frequent observation and handling, the better is the percentage of "take." We routinely look at our grafts ten days postoperatively, earlier only if indicated.

COMMENT

We have used split thick grafts, obtained by the Padgett dermatome on over eighty patients to date. Many of these patients had been severely and extensively burned and required many full drum grafts to cover the tremendous granulating lesion. On forty-two of these patients the grafts were held on by means of flamed adhesive tape, occasionally with a few reinforcing sutures. On thirty patients the graft was held on entirely by means of silk sutures. The percentage of "take" in both the above groups was satisfactory. On twelve patients the vaseline gauze contact method has been used, the percentage of "take" in this small series has been unusually high, all running above 90 per cent. No matter what method of fixation all grafts were covered with vaseline gauze, abundant sterile cotton and stockinette pressure bandages.

We would like to emphasize the warning mentioned by Padgett in his original paper on the use of the dermatome,[1] to the effect that when large areas are denuded of skin one must watch the patient carefully as the same factors must be considered as when a large amount of skin is lost in a burn. Occasionally, the freshly grafted patient may require a transfusion of blood or plasma because of loss of that substance at the donor skin site. Careful preoperative observation of the patient and a good evaluation of his physical status will in most cases bring the patient through the postoperative course without significant event.

In preparation for the grafting procedure general surgical principles should be remembered. We believe the patient should have a hemoglobin of 86 per cent or more by the Sahli instrument. We give blood transfusions preoperatively and during the entire healing period when we find the hemoglobin to be below 86 per cent. This undoubtedly aids in the healing process and helps the patient combat infection. We believe, too, that a "high-normal" hemoglobin tends to give the patient a better cosmetic and functional end result, as healing is rapid, and the grafts uniformly have a satisfactory "take" when such a procedure is followed.

We have obtained grafts from the same donor areas as many as three times, and frequently we use the same donor area twice. One may get skin from a previously denuded area approximately one month after the first graft has been taken, if the first graft was less than full thickness. Such a procedure is facilitated by using the Padgett dermatome which can cut uniform thickness grafts. In our extensive cases of burns that possibility has cut down the hospital stay of the patient markedly.

We have on occasion taken full drum split thickness grafts from a previously grafted area. We find the grafted skin from which the new graft is taken reacts exactly as does previously undisturbed skin. The freshly denuded, previously grafted area healed rapidly, and the graft obtained grows nicely to the new recipient region.

CONCLUSIONS

1. Pinch grafts are indicated only to cover the smallest of lesions probably not larger than 2 m.

2. The split thickness graft obtained by the Padgett dermatome appears to be most satisfactory to cover small and large defects in the dermis requiring no bulk.

3. To reduce the operating time in skin graft surgery in which split thickness grafts

are used, the vaseline gauze contact method is suggested.

4. A high normal hemoglobin increases the chance for a successful graft "take." Blood transfusions should be given if the patient's hemoglobin is below 86 per cent.

5. Split thickness grafts may be taken from the same donor area numerous times, allowing a suitable interval time for healing.

6. Split thickness grafts may be obtained from a previously grafted area.

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Pedicled skin grafts may be classified as simple, compound, and lined. A simple graft is composed of skin and subcutaneous tissue. A compound graft contains skin, subcutaneous tissue, and bone, cartilage, or muscle. A lined graft is a simple graft, the under surface of which is covered with epithelium by folding the pedicle or by applying an Ollier-Thiersch graft.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

JAUNDICE

SURGICAL CONSIDERATIONS

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THE primary question to the surgeon, in cases of jaundice, is the determination as to whether a medical or surgical problem is involved. Such a discriminate selection depends upon what has been called the proper evaluation of positive factors,[14] among which one can place the history, physical examination and laboratory corroboration. The repeated statement that no one factor can be pathognomonic in itself, has been proved in the many statistical surveys that have been made of such cases.

These surveys have shown that 60 per cent or more of icterus cases fall into the so-called surgical jaundice group. Snells[29] figures indicate that 25 per cent of jaundice cases are due to cholelithiasis and associated conditions; 30 per cent are caused by carcinoma, metastatic and primary in the head of the pancreas, gallbladder and ducts; 10 per cent are due to benign strictures of the common duct. This particular survey therefore, shows a 65 per cent surgical group. In Karl A. Meyers study[23] 58 per cent fell into this group, in which 32 per cent were considered malignant, and 26 per cent benign. Such studies have also shown that the jaundiced patient past middle age has a greater chance of having an obstructive type of icterus than a younger individual, and that in women, such an obstruction is most probably due to a calculus, while in man the cause is more often due to a malignancy.

While such generalizations are of value, the case that presents itself rarely follows any fixed rules and should be evaluated only in the light of what one finds. Naturally, a history of exposure to hepatotoxic substances or systemic disease will influence one toward a diagnosis of hepatosis, unless evidence of obstruction is clearly indicated.

The clinical picture in "surgical" jaundice almost always includes a story of biliary colic, yet it is not impossible that this important symptom may be missing. Pain, loss of weight, marked pruritis, nausea and vomiting, and changes in the color of the urine and stool are historical facts elicited in varying degrees. Weir[34] gives some interesting variations in what one may expect to find in a history of a stone in the common duct. It starts with the story of chronic indigestion of the gaseous type, containing qualitative and quantitative relations to food, together with the occurrence of biliary colic. Yet chronic indigestion may be absent. Colic may be absent or atypical in character and location. The patient may complain of short periods of indigestion and a sensation of fullness, or pressure and aching in the upper portion of the abdomen. At times relief is obtained by induced belching, vomiting or bowel movement. The attacks may occur at any time of the day or night, although nocturnal awaking is suggestive of organic disease. The duration of an attack may be a few minutes or an hour, and may tend to occur with increasing frequency, prolonged persistence and a residual soreness. With time, the patient complains of slight fever or chills, soreness in the upper right quadrant, and even mild jaundice of a transitory nature. Diarrhea, steatorrhea, edema, ascites, and hematemesis, are symptoms which also may be present. Yet one must keep in mind that such histories are not impossible in cirrhosis of the liver and in jaundice as a result of carcinoma of the head of the pancreas and acute pancreatitis.

Meyer and Steigman[23] give a table of the frequency of the more important findings in the history of sixty-two cases of surgical jaundice. They come to the conclusion that the main positive factory pointing to an obstructive cause removable by surgery is a history of biliary colic.

In the physical examination, the jaundice itself may be informative in as much as the obstructive type is a peculiar greenish yellow in contrast to the striking reddish yellow of a hepatosis.[34] The size, consistency and contour of the liver are determined and the presence of tenderness or rigidity noted. Meyers found the liver enlarged in 82.3 per cent of his cases that were malignant and in 68 per cent of the benign ones. Sometimes one finds a palpable enlargement of the gallbladder as well as movability and tenderness. This might be attributed either to empyema, obstruction of the cystic duct or obstruction of the Ampulla of Vater. Note should be made of scars, fistulas, sinuses, splenic enlargement,[15] abdominal masses, enlarged lymph nodes, evidence of bleeding, loss in weight and bile tophi. Of all, however, the enlarged palpable gallbladder is by far the most direct and significant factor. Hangar[18] has tabulated the difficulties of clinical differentiation between obstructive and hepatocellular jaundice:

ATTEMPTED CLINICAL DIFFERENTIATION BETWEEN OBSTRUCTIVE AND HEPATOCELLULAR JAUNDICE

	Hepatogenous Jaundice	Cancer of Pancreas	Common Duct Stone
Age	80 per cent over 40	80 per cent over 40	Usually over 40
Initial symptoms	Usually slight at onset	Insidious often no symptoms	Intermittent recurrent
Pain	56 per cent	60 per cent	95 per cent
Itching	Often absent	Often severe	Present
Weight loss.	None	Average 20 lbs.	Slight
Fever	Varies	No aid	Varies; may be Charcot
Enlarged spleen	Often	None	None
Glycosuria	None	25 per cent	None
Clay stools.	Intermittent	Present	Intermittent

It is readily evident that no hard and fast rule of differentiation can be made, based on either the history or physical examination alone.[15] It is because of this fact that the surgeon is constantly seeking other aids to give him the composite picture necessary for the classification of a case of jaundice as a "surgical" one. Chief among these aids are roentgenoscopic examinations and laboratory tests.

Such an examination of the gastrointestinal tract is valuable in excluding primary malignant lesions that have metastasized to the liver. Occasionally, widening of the duodenal loop may indicate enlargement of the head of the pancreas. Choledochograms are valuable in studying biliary fistulas, and especially patency of the common bile duct if drainage tubes are in place. Meyer and Steigman, in their series, took roentgenograms of the region of the gallbladder, and in none found shadows suggestive of gallstones, yet stones were found in this series in eight out of twenty-seven cases.

Because of these facts, a great deal of emphasis of late has been placed upon laboratory tests as an aid in determining the necessity for surgical interference in cases of jaundice. Most of these tests depend for their efficiency upon the fact that in jaundice the physiology of bile is interfered with. A new cycle is set up different from the normal one and capable of being recognized by laboratory procedures. Other tests are based upon impairment of some normal physiological functions of the liver.

The color of bile is due to several pigments the most important of which is bilirubin. The faint yellow of normal blood plasma and blood serum is probably due to this bilirubin. Normally blood serum contains less than 1.5 mg. of bilirubin per 100 cc., a coloration that is three to six times as intense as an aqueous 1:10,000 potassium chromate solution. This ratio or icteric index may increase to fifteen times before jaundice can be detected clinically by the discoloration of the skin

and sclera. By this index the progress of a case may be determined as far as latency or discoloration is concerned. Bilirubin is excreted through the bile into the intestine where it is converted into urobilogen, but is then resorbed and utilized by the liver to reform bilirubin. Urobilinogen may also be destroyed (oxidized) by the liver normally. When the liver function is impaired, this reconversion is incomplete and urobilogen appears in the urine. Urobilogen may also appear in the urine in severe hemolysis with overproduction of bile pigment. But in jaundice where there is complete occlusion of the common duct as in carcinoma and stone impaction, the bile cannot get into the intestine, with the result that no urobilogen is found in the urine. When urobilogen does begin to appear in the urine, it is an indication that bile is once more entering the intestine.

The Van den Bergh reaction is useful in differentiating between hemolytic diseases and obstruction or liver damage jaundice. Rich[26] has made an excellent summary of the theory presented by Harrop and Barron[19] which to date is the most plausible explanation of this reaction.

According to this theory, pure bilirubin at blood hydrogen ion concentration gives direct or immediate Van den Bergh reaction, but in normal plasma gives the indirect reaction due to the fact that plasma proteins absorb bilirubin thus preventing the pigment from reacting immediately with the reagent. If, however, such substances as bile salts and cholesterin, which are present in small amounts in bile and in increased amounts in the plasma of jaundiced patients, are added to the plasma before bilirubin is introduced or added at the same time as the bilirubin, the Van den Bergh reaction remains direct. This is due to the fact that substances which lower surface tension seem to be absorbed by the proteins more readily than bilirubin is adsorbed. When the protein molecules are covered with such substances, the pigment remains free. Therefore, when the plasma of a jaundiced person is tested by the Van den Bergh reaction, the direct reaction indicates that whole bile with its bile acids, cholesterol and bilirubin has been regurgitated back into the blood stream from the bile ducts, and also indicates that either an obstruction of the bile ducts or necrosis of the liver has taken place.

If the Van den Bergh is indirect we assume that the bilirubin in the plasma is pigment which the liver has not been able to remove from the blood, the abnormality consisting in overproduction of bilirubin or a depressed excretory function of the liver, or a combination of these two.

The biphasic (indirect-delayed direct) reaction is due to a high degree of pigment retention without regurgitation, or under certain circumstances to biliary regurgitation caused by obstruction or necrosis of liver cells. Rich has formulated his classification of jaundice upon this theory of retention and regurgitation.

The bilirubin elimination test[13] is based on the above theory. One mg. of bilirubin per kg. of body weight is injected into the blood and the length of time required for its elimination from the blood determined. Normally the entire quantity disappears in two to four hours. In disease of the ducts as well as liver cells, it may be retained in the blood for days.

The second group of laboratory tests, namely, those which depend upon some interference with a physiological function of the liver, is also composed of many groups. Here are found tests dealing with sugar tolerance, interference with the deaminizing function of the liver, the rôle of cholesterol and its esters, the enhancement of curtailment of enzymatic activities of the liver, the effect upon the detoxifying mechanism and disruption of plasma globulin relationships.

In the carbohydrate field, Strauss[32] has shown that when 100 Gm. of laevulose is fed on a fasting stomach, 78 per cent of those with liver disease will show the

sugar in the urine; 10 per cent of normal individuals react in a similar manner. Diminishing quantities of laevulose have been used to determine the extent of liver damage, and it has been shown that in some cases of liver damage as little as 25 Gm. will cause excretion in the urine. When galactose is used, only 40 Gm. are fed, and the appearance within five hours of more than 3 Gm. of it in urine, is suggestive of liver damage. Others have modified these tests by doing blood sugars in conjunction with the urine tests, a positive reaction consisting of a blood sugar of 135 mg. or more, with a total rise of at least 30 mg. Glucose, as well as sodium d-lactate, have also been used along these lines.[31]

The synthesis of urea[1] as a test of liver dysfunction, has not been wholly accepted. Some loss of power for urea formation is undoubtedly present. Frey[17] still believes that the urinary excretion of amino acids is important while others have shown that amino acids fed to animals with diseased livers were not excreted in the urine. Yet, tests are still made for leucine and tyrosine[21] based upon Frey's assumption. Still others look for an increase in the blood non-protein nitrogen[24] in parenchymatous liver damage, because of increased protein destruction, although here an associated pathological change in the kidney may be a factor, since damaged tubular cells prevent urea resorption.

Like other organs in the body, the liver takes part in many enzymatic activities. The use of the Ottenberg test for tyrosine depends upon the activity of tyrosinase which oxidizes this amino acid to melanin. When found in the urine of jaundiced patients, tyrosine suggests subacute degeneration of the liver or malignancy, if present in small amounts. Large amounts indicate acute liver autolysis. The status of this test is as yet indefinite.

The enzyme which has received the most attention of late is phosphatase. An increase in this enzyme was noted by Roberts in obstructive jaundice. Bodansky and Jaffe[6] produced an elevation by ligation of the common duct in dogs. Armstrong and King[4] confirmed this fact and also produced a toxic hepatitis with elevation of the serum phosphatase. Hellman stresses the importance in obstructive jaundice of a rise in serum phosphatase parallel with a rise in serum bilirubin. In contradistinction, in non-obstructive jaundice in which no such parallelism exists, the serum phosphatase remains below 10 Bodansky units despite a continued rise in the bilirubin. Borderline phosphatase readings with moderately elevated bilirubin, favors obstruction. Borderline readings with a very high bilirubin favors nonobstructive jaundice.

In addition to the many functions already mentioned, the liver is also a center for detoxification. Ordinarily, the body's first effort in the elimination of a toxic substance, is to get rid of it as such, namely, by regurgitation, vomiting, diarrhea, or skin excretion or exhalation, depending upon the nature of the toxic substance. Its chemical defense consists primarily of oxidation or reduction, or a combination of these, in order to produce either a less soluble or a less toxic radical. Failing in these efforts, the body has recourse to combination with other radicals such as sulfates, the amino acids, methylation or acetylation, to mention a few.

Many methods have been elaborated along this line, based on the theory that a damaged liver is incapable of fulfilling completely this function. Among the substances used have been, cincophen,[22] thymol and sodium benzoate. Most favored of these and most promising is the Quick[33] hippuric acid test. Its use has confirmed the idea that liver damage[7] may or may not be associated with the obstructive type of jaundice. Quick contends that the test is helpful in differentiating between obstructive jaundice in which the values are normal or high, and catarrhal jaundice in which values are markedly reduced. The ingested sodium benzoate is conjugated with amino acetic acid to form

hippuric acid which is then excreted in the urine. Normally the liver detoxifies enough of 5.9 Gm. fed, so that hippuric acid equivalent to 3 Gm. of sodium benzoate appears in the urine. As a corollary disturbed intestinal absorption may, by giving low excretion values, be diagnosed by this test.

Plasma globulin changes are recent developments in the field of liver function tests. Foremost is the cephalin-cholesterol flocculation tests. These tests are based on the fact that the liver influences the concentration of plasma proteins and the structure of the plasma globulins. When the liver is damaged the concentration of the plasma albumin decreases while the globulin may remain unchanged or actually increase. The normal A/G ratio, therefore, of 2/1 may be changed in chronic liver damage to 1/1 or even become reversed, accompanied by a general reduction of the total plasma protein. Apparently some change of the plasma globulin occurs in acute liver damage. The cephalin-cholesterol flocculation test is one in which pathological globulins flocculate a cholesterol-cephalin emulsion in varying degrees. The Hanger test[18] which is based upon this principle is simple enough, since it merely consists in mixing normal saline, serum and the antigen, allowing the tube to stand twenty-four or forty-eight hours, with a notation of flocculation and precipitation at the end of these intervals. With normal serum the antigen emulsion remains stable and homogeneous, but the sera from patients with diffuse hepatitis cause a flocculation and precipitation of the lipoidal material.

Another plasma globulin test is in the colloidal gold reaction in which the pathological globulins precipitate and change characteristically the color of the gold chloride. In the Takata Ara test, the pathological globulins flocculate and alkaline sublimate solution in serial dilutions.

The early globulin changes in acute hepatitis can be elicited by the cephalin cholesterol reaction and by the colloidal gold test. The Takata Ara test, however, becomes positive only in chronic liver disease.

Finally, we have the group of dye tests which probably enjoy the greatest popularity. These depend for their efficacy upon the ability of the liver to remove them from the general circulation and, in some instances, to excrete them into the bile passages. The rapidity with which this removal takes place is utilized as an indicator of the functional activity of the liver.

The following table (Table 1) gives an idea of the numerous dyes that have been tried and the material tested for their rate of excretion:

Table 1

Intravenous Dye	Duodenal Fluid	Sera
Congo red	X	
Indigo carmine	X	
Rose bengal		X
Azorubin S	X	
Phenoltetrachlorphthalein		X
Bromsulfalein		X
Phenoltetraiodophthalein		X

Of these, only the last four are in popular use today. In obstructive jaundice with block of the common duct from stone or other external causes, the retention reaches a high figure, not because of hepatic insufficiency, but because of mechanical interference with the channel of elimination. The phenoltetraiodophthalein is considered to have more value because larger doses can be used and simultaneous cholecystographic studies made. Normally only 5 per cent of this dyestuff is retained in the blood after an hour. Excessive retention is indicative of liver damage. These tests[3,9,27,28] are used mainly in differentiating between benign and malignant obstructive jaundice. In malignancy there is very little dye retention, while in inflammatory obstructive jaundice much of the dye is retained, the amount increasing with the length and duration of the

icterus. The explanation given is that in malignancy there is no liver degeneration, whereas in inflammation there is.

The following tabulation (Table II) is a brief resume of findings by the use of these various tests:

TABLE II

	Type of Jaundice*		
	Obstructive		Non-obstructive
	Benign	Malignant	
Test used			
Urobilogen (in urine and stool)	None†	None†	Present
Bilirubin (in blood)	Rise	Rise	Rise usually less marked
Sugar tolerance (of liver)	Normal or low	Normal or low	Low
Serum phosphatase	Rise	Rise	
Detoxicification (by liver)	Low	Normal or high	
Abnormal plasma globulins	None	None	Present
Dyes (intravenous)	Retention in blood	Very little retention in blood	

* The table assumes that a "pure" type of jaundice exists. Clinically, this is seldom the case.

† In ordinary qualitative test.

Just how important the effect of jaundice is, can be gleaned from the fact that a recent analysis of 4,000 operations on jaundiced patients showed that 16 per cent of the fatalities were due to postoperative hemorrhage. It is generally agreed that the hemorrhagic diathesis of jaundice is due to a lowered prothrombin level of the blood. This factor is always consistently low in jaundiced patients who demonstrate a bleeding tendency. Up to the time of the work of Dam and Almquist,[10,2] the cause of this was a mystery. These and other workers have demonstrated that vitamin K present in the intestine of man is elaborated by bacterial activity. In was shown that vitamin K is absorbed from the intestine in the presence of bile, the absorption occurring mostly in the jejunum. The vitamin then unites with some intrinsic factor of the liver concerned with the synthesis of prothrombin.[25] The most frequent condition predisposing to a lowered prothrombin level seems to be the absence of bile in the intestine, as in cases of obstruction of the common duct by neoplasm, stricture, stone or complete biliary fistulas. Theoretically, injury to the hepatic parenchyma should interfere with the metabolism of prothrombin. Practically, this is rare because almost 85 per cent of the parenchyma must be destroyed to affect the prothrombin metabolism. But one must remember that repeated administration of intravenous fluids in the presence of hemorrhage and the continued aspiration of bile from the gastrointestinal tract should be followed by prothrombin tests to determine the effect upon the clotting activity of the blood. Work on the chemical constitution of vitamin K has shown that a great number of compounds have similar biologic activity.[2,3,8,11–16,30] Almost all of them are derivatives of the double ring nucleus of naphthalene.

SUMMARY

It was pointed out that in so-called surgical (obstructive) jaundice, a history of biliary colic is usually obtained and is the main factor pointing to a surgical condition. A history of chills and fever and light-colored stools may also be obtained. Tenderness and rigidity of the right upper abdominal wall may or may not be present.

However, no hard and fast rule, based on either history or physical examination can be made to select those cases in which operation is indicated. Because of this difficulty laboratory tests based on disturbances of normal functions of the liver are often indicated and helpful in making a diagnosis. These tests of function fall into several main groups: (1) *Secretion of bile:* bile and urobilinogen in urine, icteric index

of blood, Van den Bergh tests of blood; (2) *storage of carbohydrate:* glucose or galactose tolerance tests; (3) *excretion or secretion of enzymes:* phosphatase in blood; (4) *detoxifying:* formation of hippuric acid from sodium benzoate; (5) *abnormal globulin formation:* cephalin-cholesterol test; (6) *dye excretion:* bromsulfalein retention; and (7) *storage of vitamin K and prothrombin formation:* prothrombin level of the blood.

Even in the most probable acute surgical cases, a preliminary period of four to six hours for parenteral administration of salt, water and glucose is necessary. Glucose replenishes the glycogen reserves of the liver and protects its cells. Vitamin K is also given to control the bleeding tendency in jaundice. Moderate amounts of protein in the form of plasma or amino acids help liver regeneration.

In those patients whose clinical picture is less acute, conservative management with salt, water, glucose, vitamin K and protein may result in the clearing up of jaundice which was due to industrial or other poisons or cirrhosis. Laboratory tests may not be able to differentiate obstruction, cirrhosis, stone in the common duct, liver abscess, metastases to the liver, or carcinoma of the common duct or head of the pancreas. Therefore, persistent signs of obstruction such as jaundice, light-colored stools, bile in the urine and a positive direct Van den Bergh test will require eventual surgical exploration.

Even when the decision to operate is difficult to make, preliminary therapy as outlined above builds up the general condition of the patient, while at the same time a few key laboratory tests can be carried out.

It is emphasized that obstruction of the biliary tract often co-exists with damage to the liver cells so that laboratory tests may not be clear-cut. It is in these cases that judgment and experience decide the course to be taken.

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WOUND HEALING†

AN EXPERIMENTAL STUDY OF WATER SOLUBLE CHLOROPHYLL DERIVATIVES IN CONJUNCTION WITH VARIOUS ANTIBACTERIAL AGENTS

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IN a previous report, certain preliminary experimental studies concerning the effect of the water-soluble derivatives of chlorophyll* upon wound healing were presented. It was noted that an overall acceleration of healing of about 25 per cent in time was obtained in somewhat over two-thirds of the experimentally induced lesions with the chlorophyll preparations as compared with any of the other twelve test agents and the bases employed in the study. The experimental lesions which were studied in rats, guinea pigs, rabbits and dogs were of three types: first, clean, surgically induced wounds; second, experimentally infected surgically induced wounds; and third, standardized dry heat, third degree burns.

Breaking down the statistical data, it was found that with the chlorophyll preparations the highest acceleration percentage figures were obtained in the case of clean wounds and burns as well might have been anticipated. In specific experiments this acceleration figure ran as high as 83 per cent and in no instance fell below 55 per cent. By contrast in a comparable group of clean cases using the other test agents and controls with their bases, the percentage figures of accelerated healing range from 0 to 50 per cent with an overall average of about 20 per cent, but with a time factor of less than 10 per cent. Indeed, *delay* in healing, especially with the sulfa drugs, was commonly encountered in these cases, the percentage varying from 5 to 67 per cent. On the other hand, in the chlorophyll treated group of clean, surgically induced wounds, *no* delay in healing was noted except in five or six cases in which secondary wound contamination developed as the result of the animal getting his dressing off.

Analysis of the figures from the experimentally infected wounds in these initial studies emphasizes the value of supplementing the wound healing effect of chlorophyll by some antibacterial agent with a wider effective range than chlorophyll alone possesses. It has been shown "in vitro"[2] that chlorophyll has definite bacteriostatic properties, and under suitable environmental circumstances apparently, even some bactericidal capacity; but the action of chlorophyll seems to be more in the nature of enhancing tissue resistance by relative acceleration of the normal repair mechanism, and perhaps by creating an unfavorable milieu for bacterial survival, than by any direct action on the bacteria themselves. This was evidenced by the fact that even in the presence of wound infection acceleration of healing was noted in 63 per cent of the induced lesions treated by chlorophyll alone. With the sulfa preparations alone the picture shifted from delayed healing in over 50 per cent of the clean wounds to acceleration of the repair process in nearly 30 per cent of the infected lesions. The same shift was noted in the series treated by the organic iodine compound, tetrodine, from a delay of about 20 per cent in the clean

* The chlorophyll preparations used in these studies have been generously supplied us through the courtesy of the Rystan Company, New York City, sole appointee of the Lakeland Foundation of Chicago.

† From the Departments of Pathology and Pharmacology, Temple University School of Medicine, Philadelphia, Pa. Aided by a grant from the Committee on Therapeutic Research of the Council on Pharmacy and Chemistry of the American Medical Association, Chicago Ill.

wounds to actual acceleration in 45 per cent of the infected lesions.

The encouraging results obtained in our preliminary studies with these water-soluble chlorophyll preparations on the healing of burns and infected wounds led us to believe that further investigation in this field, using chlorophyll* in conjunction with some of the newer antibacterial agents might prove even more fruitful. That the satisfactory treatment of burns and infected wounds still remains one of the major problems not only of the war but also of civilian life can scarcely be denied. Thus, any contribution, no matter how small, which tends to better the results obtained by our present admittedly inadequate methods of treatment, merits serious consideration.

The ultimate aims of any treatment used in such types of injury might be listed as: (1) the reduction of mortality, (2) the saving of extremities, (3) the hastening of sloughing of necrotic tissue, (4) the acceleration of healing and (5) the reduction in disfiguring cicatrix production by the promotion of normal, soft scar formation. In addition, the saving of time with its economic implications, likewise should be stressed.

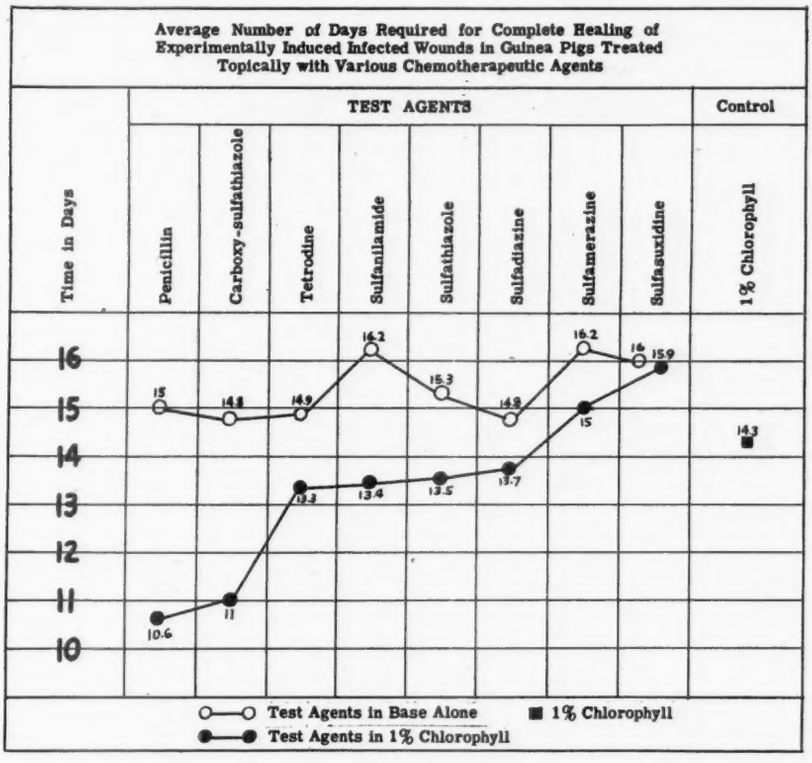

Fig. 1.

It was believed that our earlier studies had definitely established the value of "chlorophyll" as a therapeutic agent in its own right, through its stimulating effect upon normal fibroblastic proliferation,[3] in the healing of burns and infected wounds when treated topically. We had employed the chlorophyll derivatives both in saline solutions as wet dressings and in various ointment and jelly bases, without significant differences in respect to the acceleration of the healing time of the various experimental lesions. In clinical studies the wet dressings were found particularly useful during the first twenty-four to ninety-six hours in cleaning up grossly contaminated wounds. The physical characteristics of the hydrophilic jelly type

* Whenever the term "chlorophyll" is used in this paper, the water-soluble derivatives are meant, the term "chlorophyll" being used solely for the sake of brevity.

of base were not entirely satisfactory as it tended to dry out, causing the dressing to become adherent and painful unless changed frequently. The oleophilic type base had the familiar objection of merely forming an emollient, insulating layer which did not permit adequate contact of the drug to the actual wound surface.

Thus, we ultimately obtained through the co-operation of various agencies* an "ideal" ointment base which combined the features of being sufficiently emollient to resist drying out for periods of a week to ten days, while at the same time being sufficiently hydrophilic to release the medicaments incorporated in its substance at a fairly steady, slow rate. In addition several "dusting-powder" types of preparations were likewise used for comparison in the studies.

This search for an "ideal" base involved the testing of several intermediate preparations on guinea pigs before the actual investigation could get under way. In all, somewhat over 200 experimental lesions were observed during the period of their healing, half of them treated by 1 per cent chlorophyll in the particular base under consideration, the other half serving as controls and treated by the base alone. The great majority of these were clean wounds, gross secondary infection occurring in somewhat less than 10 per cent of the lesions. Acceleration of healing of the chlorophyll treated lesions, as compared with the control lesions, by approximately 25 per cent in time was found in this series in 71 per cent of cases as compared with 68 per cent in the earlier reported cases.

Lest the question be raised as to whether the effective agent in these preparations is actually the chlorophyll derivatives and not some component of the particular vehicle, some thirty additional controls were run, using simple boric acid or petrolatum on the lesions on one side and the several ointment bases, including the base finally adopted, on the other. No difference in the rate of healing was noted under these comparative conditions other than minor variations of a day or so in individual guinea pigs.

With these preliminary background studies serving as controls for the ointment bases, similar experiments were conducted using the 1 per cent "chlorophyll" ointment in combination with various antibacterial agents. Owing to limitations of time our efforts were largely concentrated on certain of the sulfa drugs, penicillin and tetrodine, as representing three of the most generally accepted types of such therapeutic drugs.

Two per cent of the following sulfa compounds were incorporated in the chlorophyll ointment: (1) sulfanilamide, (2) sulfathiazole, (3) sulfadiazine, (4) sulfamerazine, (5) sulfasuxidine and (6) a new experimental product of Lederle's—carboxy-sulfathiazole. In addition, penicillin was employed in the same manner in a concentration of 250 Oxford units per Gm. of ointment. Finally, tetrodine powder was added to the "chlorophyll" ointment to give the recommended strength of 6 per cent free and combined iodine to the preparation with the object of comparing the effect of a true chemical antiseptic with the antibiotic action of the other substances.

The entire study was carried out on guinea pigs, with the exception of a few experiments using dogs for comparative purposes. Twenty-four animals were used in the experiments with each drug. Two symmetrical lesions approximately 1 cm. in diameter were made on opposite sides of the abdomen without any attempt at maintaining surgical asepsis. The wounds were inoculated with a loopful of a twenty-four-hour broth culture of a stock hemolytic staphylococcus (c-209), covered with a

* We wish to acknowledge our indebtedness to Dr. A. O. Whipple and Dr. E. L. Howes of Columbia University, New York City, for suggestions as to the general composition of a universally satisfactory base, and to Isidor Chamelin, Goldwater Memorial Laboratories, Welfare Island, New York City, Research Fellow of the Lakeland Foundation, Chicago, for the preparation of the ointment bases used in these studies.

simple wet broth dressing to encourage bacterial growth and prevent the animal from licking the lesions clean. The following day treatment was begun. The left hand lesion in each instance was treated with the chlorophyll-antibacterial ointment. The right hand control lesions were divided into three groups of eight each. One group was dressed with the 1 per cent chlorophyll ointment alone, a second group with the ointment base alone, and the third group with the antibacterial agent in the ointment base but without chlorophyll. By this means it was believed that all possible sources of confusion in respect to the several factors involved could be eliminated. An initial tracing of the lesion was made and similar measurements recorded each time the wounds were dressed at two- or three-day intervals until healing was complete. No effort was made to determine anything but this one end point —the healing time required in each instance—in much the same practical way in which the great majority of clinical cases are treated and their progress noted. Blood levels of the drugs were not noted except in occasional isolated instances.

The results of these wound healing studies are summarized in Table 1.

At first glance, it might appear that the differences expressed by these "average" figures are not sufficiently marked to be of much clinical significance. However, on more careful examination, it becomes apparent that certain differences do exist, which tend to follow a fairly well defined pattern.

In the first place, it has been shown that 1 per cent of the aqueous soluble chlorophyll derivatives added to the ointment base accelerates the healing process in the care of wounds to an appreciable degree. It should be emphasized that this acceleration is even more marked in the larger lesions as observed in the dog experiments and in clinical cases. In other words, the "chlorophyll" itself gives evidence of having a moderate antibacterial action in the presence of infection, as well as of a stimulating effect upon the wound healing mechanism as shown in the earlier studies comparing the healing rate in lesions treated by base alone and by the base with added chlorophyll.

Table 1

AVERAGE NUMBER OF DAYS REQUIRED FOR COMPLETE HEALING OF EXPERIMENTALLY INDUCED WOUNDS (INFECTED WITH STRAIN C-209 HEMOLYTIC STAPHYLOCOCCUS PYOGENES) IN GUINEA PIGS AS TREATED TOPICALLY BY VARIOUS CHEMOTHERAPEUTIC AGENTS

Test Agent	Control Series Test Agent in Ointment Base Alone		Test Series Test Agent in 1% Chlorophyll	
	No. Lesions	No. Days	No. Lesions	No. Days
Chlorophyll ointment alone	..	....	58	14.3
Penicillin (250 units per Gm)	8	15.0	24	10.6
Sulfanilamide (2%)	7	16.2	22	13.4
Sulfathiazole (2%)	6	15.3	21	13.5
Sulfadiazine (2%)	8	14.8	20	13.7
Sulfamerazine (2%)	7	16.2	19	15.0
Sulfasuxidine (2%)	7	16.0	23	16.0
Carboxy-sulfathiazole (2%)	7	14.8	23	11.0
Total—All sulfa compounds	42	15.5	128	13.5
Tetrodine (6% iodine)	7	14.9	22	13.3

While the average acceleration with the chlorophyll ointment has been shown to be about 25 per cent in time there have been wide variations in individual cases, in some instances as much as 40 and 50 per cent.

In the second place, in *no* instance was the average time required for healing of the lesions in any of the experiments in which the supplementary antibacterial agent was combined with the ointment base *alone* as satisfactory as with the chlorophyll ointment alone. Indeed, actual delay in healing was observed in the case of certain of the sulfa drugs, notably sulfanilamide, sulfamerazine and sulfasuxidine. The individual cases show con-

siderable fluctuation in this respect, possibly due to the particular animal's constitutional susceptibility to the drug,

FIG. 2. Note chlorophyll treated lesion (A) entirely healed with control (B) showing little evidence of repair.

or possibly due in some instances to concomitant infection by supplementary secondary sulfa-resistant organisms, but with delay of as much as 50 per cent in time in some instances.

When we turn to a consideration of the experiments in which the antibacterial agent is added to the chlorophyll ointment there are several interesting observations to record. It will be noted that of all the drugs tested, penicillin,* in the strength of 250 Oxford units per Gm. of the chlorophyll ointment, gave the most brilliant results. The time required for complete healing was reduced from the 14.3 days needed with straight 1 per cent chlorophyll ointment, and fifteen days for the base and penicillin alone to an average of 10.6 days with the chlorophyll penicillin combination, an additional saving of approximately 33⅓ per cent in time. In this group there were six animals in which healing occurred within eight days. Despite the instability of penicillin, we found that the potency of the drug was reduced only negligibly over a forty-eight-hour period, if the ointment mixture was kept in the refrigerator. (This particular ointment base, containing no water, is particularly well adapted for topical use with penicillin.) (Fig. 2.)

Analysis of the results obtained with 2 per cent of the various sulfa drugs incorporated in the chlorophyll ointment yielded interesting results. The figures 13.4, 13.5, and 13.7 days, respectively, to secure complete healing with the sulfanilamide, sulfathiazole and sulfadiazine preparations plus chlorophyll are so nearly identical that it would be impossible to determine any differences in their therapeutic efficiency by this means. The healing time is reduced somewhat in all three instances as compared with that of the lesions treated by chlorophyll ointment alone. The difference, however, is not striking as in the case of penicillin.

With the sulfamerazine and sulfasuxidine in combination with the chlorophyll ointment the same delay was noted in the healing of the experimental lesions, as was observed when these sulfa drugs were incorporated in the ointment base alone. This would suggest that these drugs are perhaps more irritating when topically applied, or perhaps their slower absorption might explain the delay in controlling the infection. At all events on the basis of these particular experiments they would not appear to be the sulfa drugs of choice for topical therapy in such cases.

On the other hand, a new experimental sulfa compound, tentatively designated as 5-carboxy-sulfathiazole,* was found to be almost as effective as penicillin when used topically in the same combination with chlorophyll ointment. In twenty-three

* The penicillin used in these studies was the sodium salt prepared by the Charles Pfizer Company and was released to us for experimental purposes through the courtesy of Dr. Chester S. Keefer, Chairman of the Committee on Chemotherapeutic Agents of the National Research Council.

* This product was placed at our disposal through the courtesy of the Lederle Laboratories, New York.

animals the time required for complete healing of the lesions with this ointment was cut down from 14.3 to 11.0 days, or approximately 30 per cent. This particular sulfa compound appears to have a very low toxicity, a slow solubility and has a hydrogen ion concentration approaching neutrality.

Table II

Dog #	Test Agent Right side	Healing in Days	Test Agent Left side	Healing in Days
1	Ointment base alone	28	1% chlorophyll ointment	19
2	Ointment base alone	25	1% chlorophyll ointment	23
3	Ointment base alone	31	2% sulfanilamide ointment	34
4	Ointment base alone	27	2% carboxy-sulfathiazole ointment	28
5	1% chlorophyll ointment	21	2% carboxy-sulfathiazole ointment	27
6	1% chlorophyll ointment	24	2% sulfanilamide ointment	30
7	1% chlorophyll ointment	23	1% chlorophyll 2% sulfanilamide ointment	21
8	1% chlorophyll ointment	21	1% chlorophyll 2% carboxy sulfathiazole	18

N. B. Ointment base alone—average 27.9 days. 1% chlorophyll ointment average 21.9 days.

Finally tetrodine,* a water-soluble organic iodine product which we used in our previous studies, and which we have adopted routinely as a skin antiseptic in our experimental operative animal work, was employed in a similar manner, in conjunction with the chlorophyll ointment. Owing to the necessary low hydrogen ion concentration of the iodine preparation the resultant mixture of the two substances is not permanently stable, but by combining them freshly each time the animals were dressed, it was possible to carry out the studies satisfactorily. It will be noted that the iodine acted in its usual capacity as a chemical germicide, destroying the infecting organisms, and permitting healing to proceed at the accelerated rate noted in the other cases, under the influence of the chlorophyll factor.

* The Tetrodine was generously supplied us by the Tyler Laboratories, New York.

STUDIES WITH CHLOROPHYLL DUSTING POWDER

A small series of animals were studied in the same way using chlorophyll as a dusting powder. The chlorophyll was milled to 200 mesh fineness and combined in 1 per cent concentration with lactose, calcium lactate, sulfanilamide, carboxy-sulfathiazole, carbowax 4000 (80 mesh), and with glycine and boric acid both alone and with Tetrodine. One animal was used as a control, using the agent alone, without the chlorophyll. Three animals were treated with chlorophyll mixtures. It is our impression that none of these preparations is as satisfactory as the ointments.

DOG EXPERIMENTS

Supplementing the guinea pig experiments eight dogs were similarly treated by producing two symmetrical 7 cm. wounds in their backs. We were interested particularly in noting the satisfactory physical characteristics of the chlorophyll ointment, when applied to wounds which were more nearly comparable in size to those encountered clinically, with especial reference to the fact that it did not dry out and retained its emollient features when dressings were reapplied only at five- to seven-day intervals. In addition we were concerned with the comparative rate of healing in the larger type lesion, treated with chlorophyll ointment alone and with the sulfa compounds added. Obviously, it is impossible to draw any definite conclusions from such a small number of animals, but it seems significant perhaps that the results conform in general to those observed in the larger series using guinea pigs.

Table II gives the essential data relating to these dog experiments.

It will be noted that the best result in time was obtained with the lesion

treated by the chlorophyll-carboxy-sulfathiazole combination as was true in the guinea pig lesions. This was followed

FIG. 3. Illustrates the method of protecting dressings on dog's back by special plywood collar.

very closely on an elapsed time basis by the lesions treated by chlorophyll ointment alone, and the combination of chlorophyll and sulfanilamide. The lesion treated by the carboxy-sulfathiazole ointment alone and the controls on which the ointment base alone was used paralleled each other. There was definite delay in the healing of the two lesions treated by sulfanilamide ointment alone. The ointment base itself proved to be entirely satisfactory physically, retaining its emollient features for as long as a week. We believe it is particularly well adapted for clinical use.

Very much the same method was employed in these dog experiments as in the guinea pig studies. The wounds were intentionally contaminated to simulate actual clinical conditions. The chief problem was to keep the animals from getting their dressings off. This was accomplished by means of a wide collar (Fig. 3) made of light ply-wood, with an adjustable wedge which could be wired in position to fit the individual animal's neck.

This represented a modification and a distinct improvement over the corrugated cardboard collar previously described by us.[1] The collar did not interfere with the animal's eating, drinking, or lying down. Indeed, the dogs became accustomed to wearing the collars within a very short time, and were not bothered by them in the least. The dressings were held in place locally by adhesive supplemented by a jacket made of unbleached cotton sheeting or toweling with holes cut for the forelegs and then sewed in place on the back as previously described. The same technic was employed in dressing the guinea pigs and proved to be most satisfactory.

COMMENTS

The experimental evidence presented in these studies appears to speak for itself and requires very little discussion. It supplements our earlier studies in which the accelerating effect of chlorophyll upon wound healing was compared most favorably with that obtained by a number of other therapeutic agents rather commonly employed for that purpose. However, because of the relatively narrow range of the effectiveness of chlorophyll as an antibacterial agent, but because of its outstanding tissue growth-stimulating effect in wound healing, it was believed it might prove worth while to explore the possible advantages of combining some of the newer, more potent antibiotics with chlorophyll in the topical treatment of wounds. These hopes appear to have been fully justified by the results obtained in these experimental studies.

Critical analysis of the data serves to bring out and confirm several more or less self-apparent facts. It adds to the rapidly accumulating evidence of the tremendous value of penicillin in the treatment of infected wounds by topical application of the drug, as reported by Clark et al.,[4] Florey and Cairns[5] and many others.[6,7,8] It similarly emphasizes the perhaps less

spectacular but equally important place of the sulfonamides in the same field, supplementing the oral or parenteral administration of the drugs. The apparent relationship of the relative solubility of the sulfonamides to their effectiveness in their topical application was brought out with great clarity. The particularly good results obtained with the new experimental carboxy-sulfathiazole member of the sulfa family leads us to believe that it should be given serious consideration in the clinical field, and made the object of thorough investigation of its pharmacologic action.

These studies further confirm our favorable consideration of Tetrodine as a skin antiseptic. Its complete solubility in water, leading to deeper tissue penetration, and its remarkable low tissue irritability, coupled certainly with an equal bactericidal effect to that of tincture of iodine make it an outstanding substitute wherever tincture normally is used.

Finally, these studies augment the data which we have accumulated regarding the place which "chlorophyll" seems destined to fill in our therapeutic armamentarium in the treatment of burns and wounds. All the evidence which has accumulated from animal experimentation seems to point practically incontrovertibly to the growth stimulating effect of chlorophyll upon the development of healthy granulation tissue with concomitant acceleration of healing of both clean and infected wounds, and with the added advantage of the production of soft scar tissue instead of dense cicatrix formation. Furthermore, as shown both by *in vitro* and *in vivo*[2,3] chlorophyll appears to exert a definite bacteriostatic effect in its own right. However, in the case of grossly contaminated wounds, especially those caused by the pyogenic cocci, the addition of penicillin or certain of the sulfa drugs to the chlorophyll preparations results in a noteworthy shortening of the time required for the elimination of the infection, and of the complete healing of the lesion.

In the experiments which we have recorded in this paper, this acceleration of the whole repair mechanism by the combination of chlorophyll with such antibiotic agents gives us the impression of being what might be termed a symbiotic response, rather than merely expressing the simple cumulative effect of the two agents independently. The possibility that the chlorophyll acts in some unexplained manner as a catalyst in the process is suggested as a reasonable explanation of the phenomenon, but one which will require further exploration experimentally to establish.

Concomitantly with these laboratory studies certain clinical observations have likewise been made, all of which tend to confirm the results obtained in the animal experiments and those already reported in the literature. Among the latter should be cited the papers of Buergi,[9] Boehringer,[10] Gruskin,[11] Gahan et al,[12] Wallace[13] and Goldberg.[14] Mention should also be made of Holmes and Mueller's[15] successful use of chlorophyll ointment in the treatment of burns incidental to *x*-ray therapy. These water soluble chlorophyll preparations have been used in a wide range of clinical conditions. Their greatest value seems to be in three or four general fields of therapy, although because of the broad physiological basis of their action, many other types of disease might equally well be benefited.

Thus far, from the published literature already cited, and the clinical applications of its use with which we are familiar, it seems as if they had proved to be particularly useful in nose and throat work, especially the treatment of chronic sinus disease; in the dental field in the treatment of Vincent's stomatitis and periodontal disease (pyorrhea alveolaris), and in the treatment of burns and wounds. In this latter field the most striking results have been obtained in long standing chronic cases which have been found stubbornly resistant to all other forms of treatment.

It has been the privilege of one of us (L.W.S.) to aid (directly, or indirectly in an advisory capacity to a number of our friends) in the treatment of a number of such chronic resistant cases. These have included several longstanding cases of osteomyelitis, some of several year's duration; at least three burn cases which had failed to heal after as much as eighteen to twenty months previous therapeutic efforts, and a dozen or more cases of indolent ulcers, chiefly of peripheral vascular origin.

In many of these the results have been almost dramatic. Several extremities for which amputation had been urged have been saved, and complete healing has taken place in unbelievably short periods of as little as twelve to twenty days in a few instances.

In the dental field, the results appear to have been equally dramatic. Goldberg,[14] in his paper emphasizes the importance of the water-soluble chlorophyll derivatives in the treatment of oral sepsis, especially Vincent's stomatitis, in which he reports chlorophyll almost a specific. James,* of Temple University Dental School, confirms Goldberg's findings in a series of some 200 cases of periodontal disease.

SUMMARY

1. A preliminary study of chlorophyll in various ointment bases in over 200 experimentally induced lesions in guinea pigs showed acceleration of healing of approximately 25 per cent in time in 71 per cent of the chlorophyll topically treated lesions as compared with those treated by the ointment base alone.

2. Further studies upon a series of 192 guinea pigs with bilateral, symmetrical, infected, surgical lesions 1.0 cm. in diameter similarly treated topically with 1 per cent chlorophyll ointment combined with various of the sulfa drugs, with penicillin, and with Tetrodine were carried out.

3. Twenty-four animals were used in the experiment with each antibacterial agent, the controls being divided into three equal groups of eight animals; one-third being treated with base alone, one-third with base plus chlorophyll alone, and the final third with base plus antibacterial agent alone.

4. The topical use of penicillin in strength of 250 Oxford units per Gm. of ointment combined with 1 per cent chlorophyll gave the most spectacular results, with healing complete in 10.6 days as compared to 14.3 with chlorophyll alone, and 15.0 days for penicillin alone, an acceleration of nearly 35 per cent.

5. The sulfa compounds, in combination with chlorophyll, in general showed some acceleration of healing, through their control of infection which appeared to be roughly proportional to their solubility.

6. Carboxy-sulfathiazole was by far the most effective of these sulfa compounds, nearly equalling penicillin in that respect.

7. Sulfanilamide, sulfamerazine and sulfasuxidine alone in the ointment base actually caused some delay in healing.

8. Tetrodine employed in the same manner was of about the same order of effectiveness as sulfanilamide, sulfathiazole and sulfadiazine.

9. A small series of guinea pigs treated by chlorophyll combined with various agents as a dusting powder gave less clearly defined results and further studies do not seem warranted.

10. Experiments carried out on eight dogs with larger wounds gave comparable results to those described in the guinea pig studies.

11. The ointment base proved to be entirely satisfactory and well adapted for clinical use.

12. A discussion of the clinical possibilities of chlorophyll in combination with the various antibacterial agents is presented, and its importance in the healing of chronic types of ulcerative lesions is stressed.

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GANGRENE AND PERFORATION OF THE GALLBLADDER*

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IN reviewing the literature on the surgical treatment of gallbladder disease one is confronted with numerous clinical reports, many of which advocate diametrically opposed types of therapy. Similarly, the clinical reports presented as regards the different types of pathological lesions encountered in any series of cases, also show a great variation. The rate of advancement of the pathological process, the dangers of serious complications, and the dangers of certain types of therapy are emphatically stressed by some of the authors.

From the many articles published in the literature it is quite evident that until surgeons who are interested in clinical research become more specific in their reports and analysis, it will remain difficult to reach the proper conclusions from the papers presented.

That there is a marked difference in the application of the terms referring to the surgical treatment of the diseases of the gallbladder goes without saying; for such expressions as immediate, early and late as applied to gallbladder surgery are open to such wide interpretations that it only increases the confusion which already exists as to the method of their application to this disease.

We must also be aware of the fact that the clinical and pathological findings are frequently at wide variation and a similar divergence exists between the surgeon's postoperative diagnosis and the gross and microscopic examination as reported by the pathologist.

Being cognizant of the above, we must realize that reports based entirely upon the clinical diagnosis and the surgical description at the time of operation cannot be given the same credence as one based upon the gross and microscopic description as reported by the pathologist.

Being primarily concerned with gangrene and perforation and their allied pathological states as they pertain to the gallbladder, and attempting to be rather specific in our reports we are at first confronted with the definition of the term "gangrene." It is quite apparent that this term is also rather loosely applied. Since "gangrene" is defined as "anemic necrosis of tissue combined usually with the invasion by saphrophytic organisms," and "necrosis" is defined as "death of a circumscribed portion of tissue," it is quite obvious that the term necrosis frequently is the proper and fitting term to be applied. Since necrosis must be a forerunner of gangrene, the two processes are intimately related and consequently any discourse upon the subject of gangrene of the gallbladder must include any pathological process which predisposes to necrosis which may or may not result in gangrene.

Then the clinical term "acute cholecystitis"—Do we include acute cholelithiasis? How can we make any early differential diagnosis between the two?

Are not the advocates of immediate surgery (defining "immediate" within forty-eight hours after the *onset* of the disease) operating upon patients with a

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subsiding acute cholilithiasis and referring to same as acute cholecystitis?

This distinction is rather difficult to determine and naturally one is justified in assuming a lower mortality in a subsiding or retrogressing lesion than would occur in an advancing process; and contrary to the views expressed by Heuer[1] our data accumulated show that an overwhelming majority of these acute attacks subside spontaneously and it is by far the exception that the pathological process progresses to the point of necrosis, gangrene or perforation.

Further, the close observation of the patient will definitely decide whether the process is advancing or regressing and surgery can be instituted at any time if need be.

One must also be specific as to the pathological group one is dealing with, for the percentage of gangrene and perforation in a general series is naturally expected to be far below that of a series of patients suffering from acute cholecystitis.

Any student on this subject cannot help being impressed and bewildered by the marked variation in the percentages of gangrenous and perforated gallbladders reported as a result of acute cholecystitis.

Thus Heuer[1] reports a 26 per cent occurrence of gangrene and perforation in his new New York Hospital series and Behrend[2] reports a zero per cent, stating that he has seen but one perforation in twenty-five years and that was in a newly formed gallbladder following a previous cholecystectomy.

Similarly, the mortality resulting from gangrene and perforation shows a like variation in that Alexander[3] reports a mortality of 50 per cent in acute perforation and 25 per cent in subacute perforation while Heuer[1] reports a mortality of 12.5 per cent in a series of sixteen cases with demonstrable perforation of the gallbladder, fifteen of which had an extracholecystic abscess and one with generalized peritonitis.

Although Heuer does not state the number of free and walled-off perforations in this series, we believe that we are justified in assuming that the fifteen with the pericholecystic abscess were walled-off perforations and possibly the patient with generalized peritonitis had a free perforation. His mortality as reported in a series of 153 patients with cholecystitis operated upon during the acute phase, forty of which showed areas of gangrene and sixteen with perforation was 3.2 per cent.

It is this marked variation in the occurrence of gangrene and perforation of the gallbladder and the resultant variation in the mortality rates that prompted us to undertake a study of gangrene and perforation of the gallbladder and allied conditions.

Needless to say there are many points that are in need of clarification and until universal terminology as applied to the surgical treatment of diseases of the biliary tract is adopted it will remain difficult properly to evaluate the reports presented by the students on this particular subject.

To cover the topic properly we have divided all the patients admitted for acute cholecystic disease or those that were admitted after subsidence of the acute attack exclusive of tumors, into two main divisions, namely, those patients treated medically and those treated surgically.

Under the diagnosis of acute cholecystitis we are grouping all patients who were admitted during an acute attack of biliary disease and we are not attempting to differentiate between acute cholelithiasis and acute cholecystitis. We do emphasize the fact, however, that the attack was of such severity that hospitalization was considered emergent.

The surgical subdivision was reclassified into four groups: (1) ulcerative cholecystitis, (2) infected hydrops or so-called empyema, (3) necrosis or gangrene without perforation, and (4) perforation.

The perforative group was further subdivided into (1) healed perforation or internal biliary fistula, (2) walled-off perforation or pericholecystic abscess, and (3)

free perforation. Our review covers the admittances to the Los Angeles General Hospital over a period of four years, namely, from January 1, 1938 to January 1, 1942.

During this period there were admitted for treatment to the Los Angeles General Hospital a total of 1,699 patients suffering from an acute attack of biliary disease or giving a history of a previous acute episode. Of this number, 895 were admitted to the medical service during the acute phase and later were either dismissed, the acute episode subsiding, or were transferred for elective surgery or died. Eight hundred four were operated upon, being transferred for elective surgery, or readmitted at a later date as ambulatory patients for elective surgery. One hundred fifty-four were admitted as ambulatory elective patients but with a history of previous acute attack.

The surgical group contains all that were operated upon, and, in order to avoid duplication all in this group that were transferred from medicine for elective surgery are not included in the medical group.

In view of the high percentage of gangrenous and perforated gallbladders reported and the stress placed upon the dangers of these pathological conditions it was decided to analyze first the group which was treated medically.

Since all in this group (895) were admitted with a diagnosis of acute or recurrent attack of cholecystitis or cholelithiasis and none were operated upon, we believed that this would give us some definite information as to the dangers of gangrene and perforation with the resultant mortality.

In this group we have placed all patients admitted with an acute syndrome which was more or less typical of acute biliary tract disease (acute cholelithiasis or acute cholecystitis) and of such severity to warrant admittance to the hospital. The majority of the staff at this institution favor the delayed type of therapy (waiting for subsidence of the acute symptoms and performing the surgery during the quiescent stage). Consequently, all patients with this syndrome are admitted to the medical service with the exception of those in which immediate intervention is contemplated. These are admitted direct to the surgical service. Any of course that are in need of emergent care after reaching the medical service are promptly transferred to the surgical service.

None in this entire group were subjected to surgery for one of the following reasons: (1) The patient was moribund upon admittance, (2) the patient was suffering from some concomitant disease of such severity that the surgeon refused to operate, (3) the patient refused surgery, or (4) the patient was dismissed and told to return at a later date for elective surgery. Many of these patients had had a previous admittance for acute cholecystitis with spontaneous subsidence of the attack and an overwhelming majority gave a history of previous similar attacks.

We must frankly acknowledge the possibility of error in the clinical diagnosis, but since by far the greatest percentage of deaths had a necropsy performed the results of which substantiated the clinical diagnosis, we believe we are justified in concluding that the clinical diagnosis was correct in a very high percentage of all the cases studied.

Of the total of 895 non-operative patients admitted to the medical and surgical service with a diagnosis of acute cholecystitis fifty-two died, which represents a non-surgical mortality of 5.81 per cent.

Here is a group of approximately 5.81 per cent to which little, if any, attention is paid as far as reduction of mortality is concerned. If both the advocates of delayed and immediate therapy would focus their attention upon this group, a substantial reduction of mortality could be achieved. By far the greatest percentage of these patients have had previous acute attacks and until this group of patients is brought to surgery at an earlier age, little in the actual reduction of mortality can be expected; for there is no doubt that therapy

instituted at an earlier age whether it be immediate, early or delayed would show considerable reduction in the death rate. Just as the death rate of appendicitis has been reduced by educating the public into recognizing the symptoms and the advantages of early surgery, just so, in a similar manner, the education of the public as to the value of surgery at the earliest possible opportunity in case of gallbladder disease will achieve similar results.

In analyzing the non-surgical deaths we find the following: 69.23 per cent of the deaths occurred in patients over sixty-three years of age; 48.07 per cent of the deaths occurred within seventy-two hours after admittance; 34.7 of the deaths were due to common duct obstruction with its sequelae; 17.13 per cent were admitted in coma or semi-coma. With but few exceptions these patients had repeated attacks of biliary colic and inflammation of the biliary tract. Practically all of these patients had some serious concomitant disease. However, of these fifty-two deaths only twenty-two were due to gangrene and perforation which brings the mortality to 2.45 per cent.

When we consider the fact that the overwhelming majority of these patients had one or more previous attacks with spontaneous recovery we believe that we are justified in concluding that the danger of death due to gangrene or perforation in non-surgically treated patients is far less than 1 per cent.

Nevertheless this entire group represents a considerable mortality for whom little has been attempted and much should be done. This must be considered a so-called forgotten group.

One must also be appraised of the fact that all these patients either refused surgery, or the surgeon refused to operate because of the presence of some other pathological condition, or the patient was moribund upon admittance to the hospital. Therefore, these deaths represent a group more or less beyond surgical help, for certainly better physical conditions may have spared some lives by surgical intervention which would lower the mortality of the medically treated group. Many of these have also had previous admittances for acute cholecystitis and almost all gave a history of one or more previous acute attacks.

These figures show a marked variation as compared to the statistics presented by the following: Thus, Clute[4] encountered 14 per cent with gangrene and perforation, Kernath[5] 27 per cent and Heuer[1] 26 per cent.

The remaining 804 patients were admitted to the surgical service with an acute attack or having a history of having had one or more previous acute attacks.

As previously stated we have divided the surgical patients studied, into four groups. Since superficial ulceration means localized necrosis and, necrosis loosely applied means gangrene, we believe that in a study of gangrene and perforation, this group deserves attention; for the localized areas of gangrene and perforation probably are always preceded by ulceration of the mucosa.

In group two we have placed infected Hydrops which is developed through obstruction of the cystic duct. This pathological condition undoubtedly preceded many of the perforations and probably many of the pathological states in which the entire gallbladder becomes gangrenous. Indeed it is quite possible that in cases of perforation some type of obstruction is always present.

In group three we have placed all the patients suffering from some form of necrosis or gangrene of the gallbladder without perforation and in group four we have placed all the perforations.

The perforative group was again subdivided into (1) healed perforation or internal biliary fistulas, (2) localized perforation or pericholecystic abscess and (3) free perforation.

In our study we have accepted the pathologists report, if available, as the final diagnosis. Needless to say the clinical report, the surgical report, and the patho-

logical report frequently showed a wide variation and we believe that in presenting statistics of this type the pathological report must be accepted as final.

In the first group, that of ulcerative cholecystitis, including the healed process, we have a total of 115 patients which represents 6.76 per cent of the total admittances of patients with an acute attack of biliary disease or having a history of one or more previous acute episodes. Of these all but twenty-one were admitted with an acute attack and surgery performed in the interval, and all but one had a cholecystectomy. There were four deaths or a mortality of 3.44 per cent.

All deaths were females, their ages being fifty-two, fifty-nine, sixty-three and seventy-five. All were operated upon after the subsidence of an acute attack and were in the so-called elective group.

This group presents unmistakable evidence that gallbladder disease is reversible disease and in far the greatest percentage of instances regardless of the fact that superficial ulceration or necrosis is present the pathological process tends toward spontaneous resolution.

Since this mortality is less than one-half of the reported general mortality of 7.06 per cent at this institution,[6] it is possible that as far as this group is concerned the ulcerative lesion to a certain extent may have improved the patients' resistance, thereby preventing postoperative complications which lead to a fatal outcome.

INFECTED HYDROPS OR SO-CALLED EMPYEMA OF GALLBLADDER

Since obstruction of the cystic duct whether due primarily to inflammation or secondary to stone is directly responsible for hydrops formation and an infected hydrops must be considered as potential perforation unless the internal pressure is relieved, we have therefore included this group in our study. The necrotic process may be either localized or generalized depending upon the type of a pathological lesion which is encountered.

In this group we have sixty-nine patients who were admitted during an acute attack and operated upon either as emergency or elective patients, or were later readmitted for elective surgery. Of these, fifty-six were subjected to some type of surgical procedure and the remaining thirteen were not operated upon for various reasons.

Of the thirteen non-operative patients four died, a mortality of 30.76 per cent. Three of these patients were females and one a male the ages being as follows: fifty, fifty-two, fifty-three and eighty-one. The first patient was admitted in diabetic coma, the second had extensive carcinoma of the breast, the third glomerulonephritis with uremia and the fourth refused both study and surgery. Of the fifty-six patients subjected to surgery, four died or a mortality of 7.10 per cent.

In further analysis of this group we find that twenty-six patients had a cholecystectomy and thirty patients had a cholecystostomy. These groups were further subdivided into those who received emergency surgical care and those who were finally operated upon as elective patients.

Of the twenty-six cholecystectomies, ten were performed as an emergency, and sixteen as an elective procedure. Of these performed as elective procedures there were no deaths and of those performed as an emergency procedure there was one death, a mortality of 6.25 per cent. Of the thirty cholecystostomies, seven were performed as elective procedures without a death and twenty-three were performed as emergency procedures with three deaths, or a mortality of 13.04 per cent. These three patients were desperately ill at the time of admittance and immediate emergent surgery was performed, the ages being fifty-nine, sixty-seven and seventy-six, the latter being a female.

Apparently in further analyzing this group, with the possible exception of the death from an emergency cholecystectomy which may possibly have been avoided by performing a cholecystostomy, the only

possible opportunity of reducing the mortality in this group is by earlier hospitalization for surgery or interim surgery. Here again, immediate, early or delayed surgical treatment would not reduce the mortality, but education of the patients to seek earlier medical attention, and stressing to the profession the necessity for early hospitalization for study or surgical care would, no doubt, have a beneficial result.

GANGRENE

In the group in which gangrene was diagnosed by the surgeon we have a total of twenty-six patients representing 1.53 per cent of the total admittances with an over-all mortality of 12.5 per cent.

The age and sex of the surgical deaths were as follows; male, forty-eight, admitted in coma and was an old hemiplegic with a history of two cerebral vascular accidents, operated the day of admittance; male, fifty-seven, operated nineteen days after admittance but eviserated which resulted in this patient's death; male, sixty-three, operated seventeen days after admittance, the postmortem diagnosis being uremia and acute necrosis of the liver with an area of necrosis in the gallbladder. Undoubtedly, the reason for delaying surgery in two of the above was a question of improving the patients' physical condition. The two non-surgical deaths occurred the day after admittance.

Certainly all five of these deaths were unavoidable as far as the treatment at the time of admittance was concerned and could have been avoided only by bringing these patients to surgery at a younger age.

In this group there were six cholecystostomies with one death or a mortality of 16.66 per cent, while in the group of eighteen cholecystectomies there were two deaths with a mortality of 11.11 per cent. Here again the possibility of a cholecystostomy performed in place of cholecystectomy may likely have reduced the mortality, but the fundamental cause for the deaths was that these patients did not come to surgery at an earlier date.

INTERNAL BILIARY FISTULA

In this group (4A) we have a total of thirteen patients or .76 per cent of the total admittances. There were six deaths representing an over-all mortality of 46.15 per cent. However, of this group, nine were subjected to surgery with two deaths, or a surgical mortality of 22.22 per cent, while four were not operated upon with a mortality of 100 per cent.

The ages and sex of the operative deaths being female, sixty-two, female sixty-four, and the cause of death in both being intestinal obstruction. Of the non-operative deaths all patients were in extremely poor condition and the age, sex and cause of death were as follows: male, age eighty-seven, perforation of bowel due to gallstone; female, sixty-nine, died day of admittance, choledochoduodenal fistula with ascending choleangitis with multiple liver abscess; male, age one-hundred, died day after admittance of a cholecystogastric fistula with common duct stone with obstruction, and a male, age sixty-eight, intestinal obstruction due to gallstone. As one will note the age group of the non-operative deaths is in the higher brackets, all poor risks and the preoperative diagnosis rather obscure at times. All these patients undoubtedly have had previous biliary tract symptoms.

The possibility of intestinal obstruction due to a gallstone must always be considered in any acute abdominal condition particularly if a history of jaundice is obtained.

This group which represents but .76 per cent of the total admittances again presents a mortality group which can expect very little help of immediate, early or delayed type of therapy but will be aided only by bringing these patients to surgery at an earlier age or date.

Eight of these patients had the premortem diagnosis of intestinal obstruction due to gallstone correctly established.

PERICHOLECYSTIC ABSCESS

In this group (4B), namely, that of pericholecystic abscess or walled-off per-

foration we are dealing with an active, acute, pathological process which may have subsided clinically. This type of lesion probably is produced from localized ulceration followed by necrosis of a localized area of gallbladder with resultant perforation. This perforation may occur into the liver substance itself or into the surrounding organs, particularly into the omentum which became adherent to the gallbladder serosa before actual perforation occurs.

In this group we have a total of eighteen patients representing 1.05 per cent of the total admittances. Of these, seventeen were subjected to surgery with one death or a mortality of 5.88 per cent. However, the total mortality was 11.11 per cent, there being two deaths, one of which was non-surgical. In the surgical group there were four males and thirteen females, the age groups being as follows:

20–29	30–39	40–49	50–59	60–69
1	4	2	3	7

The non-operative death had had a diagnosis of cirrhosis of the liver and carcinoma of the head of the pancreas previously made with the peritoneoscope. This diagnosis was disproved at autopsy, the cause of death being due to a common duct stone and perihepatic abscess. This entire group of patients all gave a history of previous acute attacks.

Here, again, we have a surgical mortality of 5.88 per cent which is lower than the average mortality of 7.06 per cent as previously reported by one of us.[6] Seven or 41.17 per cent had a cholecystectomy and seven or 41.17 per cent had cholecystostomy while three or 17.65 per cent had simple drainage of the abscess.

The only death was that of a sixty-four year old male who had but a simple drainage of the abscess. This patient was operated upon ten days after admittance. Certainly a more simple procedure could not have been performed but the possibility of earlier surgery may have spared this life; yet as a whole the surgical mortality of this group was smaller than the mortality of a general operative series.

PERFORATION

This group (4c) which ordinarily represents the one with the highest mortality contained a total of thirty-three patients representing 1.94 per cent of the total group. There were fourteen deaths or a mortality of 42.42 per cent. There were twenty-two operative patients with three deaths or a mortality of 13.63 per cent. As expected, the non-operative mortality was 100 per cent.

This group and pericholecystic abscess should possibly be considered together but in this group a perforation of the gallbladder was described by the surgeon while in the pericholecystic abscess group no perforation was described, the perforation probably having sealed or not found.

The age groups were as follows:

20–29	30–39	40–49	50–59	60–69	70–79
1	0	5	9	6	12

Thus, 81.81 per cent of the perforations occurred in the group over fifty-two years of age and over 57.57 per cent occurred in the age group over sixty years of age.

The surgical deaths with the exception of one patient, a female who was operated upon as an elective patient and died from gangrene of the abdominal wall at the age of forty-four were in the advanced age group, their ages being sixty-nine, seventy-one and seventy-three, respectively.

In the non-surgical deaths, ten in number, 60 per cent were seventy years or older.

Here, again, is a group of patients, ten of whom died, without surgical intervention which represented a total of 71.42 per cent of the mortality.

Certainly, regardless of the type of therapy instituted little reduction in mortality could be obtained; bringing these patients to surgery at an earlier age un-

doubtedly would contribute tremendously toward the reduction of the mortality.

COMMENTS

This entire series represents a total of 1,699 patients admitted during an acute attack of biliary tract disease or who were admitted for elective surgery following the subsidence of the disease.

Of this total 115 or 6.76 per cent were found to be suffering from superficial or healed ulceration, thirty-four or 2.0 per cent from gangrene, fifteen or .88 per cent from internal biliary fistula, eighteen or 1.05 per cent from pericholecystic abscess formation and forty-five or 2.64 per cent from free perforation, showing a total incidence of 1.36 per cent of some type of necrosis or gangrene.

Deleting the ulcerative group the incidence of gangrene and perforation among the total admittances is 6.82 per cent. There were twenty deaths among the patients suffering from internal biliary fistulas, gangrene, perichelecystic abscess or free perforation on the medical service and nine operative and eighteen non-operative deaths on the surgical service or forty-seven deaths, making an over-all mortality of 2.76 per cent. Of these deaths, thirty-eight were non-operative which comprised 80.85 per cent of the total mortality, placing the surgical mortality at .53 per cent and the medical mortality at 2.23 per cent.

On the surface the incidence of gangrene and perforation appear rather high but not near as high as some of the statistics previously quoted. Yet in all sense of fairness in reaching the correct conclusions one would have to determine the number of acute attacks each patient in this series experienced to determine correctly the possible danger of gangrene or perforation of the gallbladder. If the average attack per individual be placed at two, this would immediately reduce the danger of gangrene 50 per cent. Although we have no exact figures to prevent, we are of the opinion that the average attack per patient before surgery is instituted is far above two, consequently the danger of some type of gangrene developing from an acute attack is rather small.

However, the deaths from the gangrenous group represent a mortality which must be reckoned with, but by far the most important group in the reduction of mortality from biliary tract disease is the non-operative or the forgotten group, a group about which little is heard, while the exponents of the different types of surgical therapy expound the virtues of each. If the adherents to the different types of therapy would pause but a moment and give this group the proper consideration, a substantial reduction in the mortality of disease of the biliary tract could be obtained. The proper education of the public to the fact that the removal of a diseased gallbladder is necessary as soon as possible will undoubtedly stave off some of the serious complication at a later date, and be a marked contribution toward the lowering of this mortality.

For the more recurrent attacks the patient has, the older the age, the more likely it is that the patient may also be suffering from some serious concomitant disease all of which will contribute to the mortality.

CONCLUSIONS

1. The danger of gangrene and perforation is overstressed by the group that favors immediate surgery.

2. Neither delay nor early surgery will spare the patient who seeks hospitalization when he is moribund.

3. Greater attention should be paid to the forgotten group through proper education, thereby bringing the patient to surgery at an earlier age.

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TUBERCULOSIS OF THE BREAST*

REPORT OF NINE CASES INCLUDING TWO CASES OF CO-EXISTING CARCINOMA AND TUBERCULOSIS

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THE purpose of this paper is to add nine additional cases of mammary tuberculosis to the literature, including two cases of concurrent tuberculosis and carcinoma of the breast.

History. Since Sir Astley Cooper, in 1829, first described the condition as "scrofulous swelling of the bosom" there had been approximately 500 reported cases in the literature, and several excellent articles reviewing the subject are listed in the bibliography. As Grimes and Massie[1] pointed out in their article, interest in tuberculosis of the breast lies first in its comparative rarity; second, in the difficulty of making a clinical diagnosis; third, in determining whether the condition is primary or secondary in the breast; and fourth, in determining the portal of entry of the tubercle bacillus. Some of our cases will be discussed with relation to the above points, and a glance at our charts showing our preoperative diagnoses compared to the pathologic findings emphasizes our inability to make a correct clinical diagnosis with any degree of accuracy.

Incidence. The incidence of tuberculosis as compared to other lesions of the breast ranges in various series from 0.54 per cent reported by Nicolson and Gillespie[2] to 1.87 per cent reported by McGehee and Schmeisser.[3] Thus roughly one out of every one hundred breast conditions is tuberculous mastitis.

Etiology. The tubercle bacillus is the causative agent but the portal of entry is frequently difficult to determine. Invasion of the breast might occur by one of the following routes: (1) Through the milk ducts by way of the nipple; (2) through abrasions of the skin; (3) by direct extension from the lungs and chest wall; (4) through the blood stream, and (5) through the lymphatics. Interesting cases are cited in the literature to support the various routes above outlined but there is general agreement that in most cases, the tubercle bacillus is carried to the breast by retrograde extension through the lymphatics from tuberculous cervical, axillary or mediastinal lymph nodes. Several of our cases bear out this method of spread. Evidence against the invasion of the breast through the blood stream is found in the work of Negastkima[4] who performed complete autopsies on thirty-four patients who died of miliary tuberculosis. He sectioned the breast and subjected them to microscopic study, smear and guinea pig inoculations without finding a single instance of breast involvement. Trauma may be an etiologic factor in certain rare instances but on the whole plays a minor part. It is agreed that heredity is of negligible importance. Tuberculosis of the breast is most common in women in the age group between twenty and fifty. (In our series the average age was thirty-five years.) Although pregnancy and lactation are predisposing factors in the etiology, about 20 per cent of the women with mammary tuberculosis were single, and approximately 4 per cent of all the reported cases were in male patients.

Classification. For practical clinical purposes the disease is divided into the

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primary and secondary types. When there is no demonstrable evidence of tuberculosis elsewhere in the body, the condition is classified as primary tuberculous mastitis. Most cases are of this type, although there is the possibility that there is a primary focus elsewhere. In the secondary type, there is evidence of tuberculosis in other parts of the body, such as the lungs, bones, pleura or lymph nodes. A useful classification based on the gross pathology divides the cases into three groups:

1. *Nodular.* The tubercle which is usually situated in the connective tissue enlarges to form a lump which may range from 2 to 10 cm. in diameter. As the condition progresses, caseation and suppuration occur and sinus formation may develop. In the disseminated varieties, daughter tubercles may form at the periphery, and in the confluent type the nodules which have undergone caseation, necrosis and liquefaction communicate through fistulous tracts.

2. *Sclerosing.* This form is characterized by excess fibrosis and is seen more frequently in older people.

3. *Atypical.* In this group are included rare types of lesions such as obliterating tuberculous mastitis and intraglandular cold abscess.

On section, the specimen may resemble chronic mastitis with greyish discoloration of the normally white breast tissue. Localized areas of caseation and cyst formation may be present. The microscopic appearance establishes the diagnosis. One should see tubercles with caseation, Langhans giant cells with peripheral nuclei, and epithelioid cells.

Smears, cultures and guinea pig inoculation may be taken but it is frequently difficult to find the bacilli especially in cases of sinus formation in which secondary infections by pyogenic organisms are superimposed. In only one-fourth of the 439 cases reviewed by Morgen was the organism found. The organism is also difficult to isolate in the pathologic sections.

Diagnosis. Most patients are in apparent good health. The most frequent presenting symptom is a lump in the breast, which is usually painless. (This is present in approximately 70 per cent of the cases.) Pain is complained of initially in only about 8 per cent of the cases. Another presenting complaint may be a referable, persistent, discharging sinus after spontaneous rupture or surgical incision and drainage of what appeared to be a pyogenic breast infection with abscess formation. A discharging sinus is present in from 20 to 50 per cent of the lesions. Enlarged axillary nodes may be noted by the patient and are reported to be present in from one-half to two-thirds of the cases. The variable physical findings depend upon the stage of the disease and the type of the underlying pathological condition. A discrete, non-tender, circumscribed mass may be felt, resembling a benign tumor or a cyst. On the other hand, one may find a lump which is attached to the skin, with nipple retraction and with associated palpable non-suppurating axillary nodes. In this type we believe it is impossible to differentiate between carcinoma and tuberculosis clinically. Then again examination may reveal signs of acute inflammation with swelling, heat, redness, tenderness and possibly fluctuation suggesting abscess formation, or there may be signs of chronic breast inflammation with the overlying skin fixed, thickened, red and ulcerated or perforated by one or more discharging sinuses. In the latter, the condition may simulate a broken down gumma or actinomycosis of the breast.

To make the problem even more difficult, there may be associated tuberculosis and carcinoma in the same breast. Approximately twenty-six cases have been reported to date and our series includes two more. The condition is almost always unilateral. Frequently one can palpate enlarged axillary nodes, and sometimes supraclavicular and cervical nodes. If the nodes have broken down, sinuses will be present.

In the series of seven cases reported by Nicolson and Gillespie,[2] the condition was

correctly diagnosed preoperatively in all the cases; however, in the various series in the literature, and especially in our own, the preoperative diagnosis of tuberculosis of the breast was usually not made. The most frequent clinical diagnosis was carcinoma and unless a frozen section was performed at the time of the operation the patient might unnecessarily be subjected to the ordeal of a radical mastectomy when a simple mastectomy would have sufficed.

When sinuses are present or when tuberculosis is present in other parts of the body, such as the lungs, lymph nodes or skeletal system, the diagnosis should be suspected immediately.

FIG. 1.

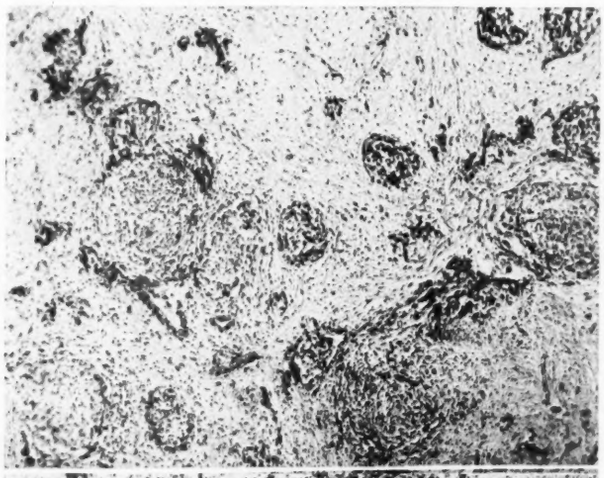

FIG. 2.

FIG. 1. Case 1. Combination of tuberculosis and carcinoma of breast. Section showing a number of tubercles interspersed with small nests of carcinoma cells; microphotograph × 110.

FIG. 2. Case 1. Combination of tuberculosis and carcinoma of breast. Section showing nests of carcinoma cells in a fibrous connective tissue stroma. Note presence of a tubercle at bottom of field; microphotograph × 110.

In the study of material obtained by aspiration or from a sinus suspected of being tuberculosis, it is well to remember that a single report is not sufficient to rule out tuberculosis. Secondary infection by pyogenic organisms is frequent and the routine culture and smear will easily show these organisms at a glance, while the tubercle bacilli which stain with difficulty and are less numerous may be impossible to demonstrate by these methods in the

face of heavy secondary infection. For this reason a routine culture and smear reported negative for tuberculosis is not conclusive in ruling out the condition, and guinea pig inoculation is therefore advisable in all cases. In one of our cases (Case IX) smears and cultures taken from discharging breast sinuses were reported as showing the presence of actinomyces plus streptococcus anhæmolyticus and staphylococcus. We were preparing to present the case as one of actinomycosis of the breast when the guinea pig report proved the presence of acid-fast bacilli.

X-ray of the chest should also be done in all cases with suspicious breast lesions because 12 to 16 per cent of the cases of mammary tuberculosis have positive pulmonary tuberculosis.

Differential Diagnosis—*A—In Patients Having Discharging Sinuses:* (1) simple pyogenic mastitis; (2) degenerated gumma; (3) actinomycosis; (4) carcinoma. (1) In chronic pyogenic mastitis, pathological study of scrapings from sinuses should fail to show tuberculous granulation tissue. Heavy secondary infection may distort the typical pathological picture of tuberculosis. (2) Gummas are very rare. (3) actinomycosis, diagnosed by demonstration of the ray fungus in the discharge. (4) In carcinoma with sinus formation, microscopic study of tissue obtained by curetting or biopsy.

B—In Patients without Sinus Formation:

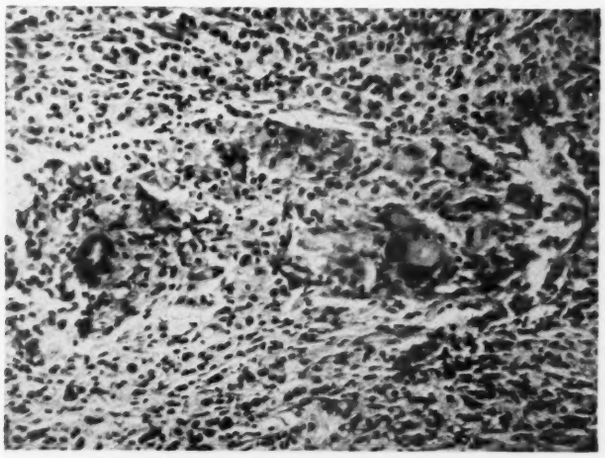

FIG. 3. Case 11. Tuberculosis and carcinoma of breast. Section showing a nest of conglomerate tubercles surrounded by fields of medullary carcinoma; microphotograph × 300.

(1) Carcinoma—In the nodular type of tuberculosis there may be a painless mass, skin fixation and palpable axillary nodes. We believe this type to be indistinguishable, clinically, from carcinoma. In this connection Nicolson and Gillespie state that tuberculosis occurs in younger people and the tumor increases in size more rapidly. Nipple retraction is more frequent in carcinoma and nipple discharge is more frequent in tuberculosis. The discharge is usually purulent in tuberculosis, but in carcinoma it is serous or sanguineous. Sclerosing tuberculous mastitis may so closely resemble carcinoma that even on gross section one could not distinguish between them. (2) Benign fibro-epithelial tumors are freely moveable, circumscribed and have no skin fixation or axillary node involvement. However, in one of our cases with these features and a preoperative diagnosis of fibro-adenoma, the pathological report after excision was carcinoma as well as tuberculosis. (3) Chronic cystic mastitis—usually bilateral, of longer duration, pain more frequent and usually more severe just before onset of menses. The skin is involved frequently in tuberculosis but not in cystic mastitis. Nipple retraction

is more frequent in tuberculosis. Aspiration and study of the fluid from the cyst, including guinea pig inoculation, should be done in doubtful cases. Axillary nodes may be present in both conditions and are, therefore, of no differential importance. Rarely cystic may so closely simulate tuberculous mastitis that a biopsy is needed to make the diagnosis. (4) Gummas are rare. A negative Wassermann test is not able to rule it out completely. A therapeutic test and provocative reaction are helpful. (5) Plasma cell mastitis is differentiated from carcinoma and from tuberculosis by the acute onset and by rapid response in two to three weeks following a small amount of radiation therapy. (6) Traumatic fat necrosis may resemble carcinoma or tuberculosis. A history of injury preceding the onset of symptoms should make one suspect this condition.

Prognosis. In primary cases in which the patients are properly treated the prognosis is good. Untreated, the condition may spread to the thorax and its viscera or to other organs and lead to a fatal outcome. Lee and Floyd[7] state that there are no proven cases of breast tuberculosis which have spontaneously recovered. In secondary cases the prognosis depends upon the primary focus and its activity and extent.

Treatment. Many forms of therapy have been used in the past including curettage, cauterization, aspiration, incision and drainage and injection of the sinus with various preparations. More recently, Berger and Mandelbaum[6] reported on the use of tuberculin inunction plus heliotherapy in one case and they believed that further trial of this type of therapy was justified.

The generally accepted treatment of choice is excision. Occasionally, small, localized lesions may be removed with an adequate amount of normal breast tissue but usually simple mastectomy is necessary. Routine pre- and postoperative radiation therapy is advocated by some; others believe that postoperative radiation should be given only when accompanying axillary lymph nodes are involved. A smaller group of surgeons advise radical mastectomy when the axillary lymph nodes are affected.

In non-surgical treatment or in the treatment of recurrences, roentgen therapy is recommended.

CASE REPORTS

Case I. Patient, M. B., No. 30969, a forty-eight year old female, was admitted with a history of pain in the right breast of a sharp, shooting character and a mass of one month's duration. There were occasional shooting pains radiating to the right axilla. The patient was married and had one child who was living and well. It was not known whether the patient nursed the child or if there was any history of tuberculosis.

Examination revealed a walnut-sized mass in the upper, inner quadrant of the right breast. It was firm, not tender. It was not attached to the skin but was embedded in breast tissue. The nipple was normal, no orange skin. No palpable glands were present.

A preoperative diagnosis of fibro-adenoma of the breast was made. At operation the mass and surrounding normal breast tissue were excised. The postoperative diagnosis was the same as the preoperative diagnosis. The patient was discharged on the third postoperative day.

Pathological report, No. 6906, gross—1 cm. translucent tissue. Microscopic—adenocarcinoma arising in the ducts. Other sections showed conglomerate tubercles and giant and epithelioid cells. Diagnosis: carcinoma and tuberculosis of the breast.

The patient died seven years later with metastases to the supraclavicular area and to the thyroid.

Case II. Patient, J. M., No. 13772, a thirty-three year old female, was admitted with a history of a mass in the left breast of one year's duration; there was no pain but progressive enlargement of the mass. The patient had ten children. Twelve years previous to admission a newborn infant died and lactation was suppressed. A small nodule appeared but soon disappeared. Five years prior to admission the patient was struck on the left breast by a ball. A mass developed but it disappeared.

Examination revealed a firm mass, the size of an egg, irregular in shape in the upper inner quadrant of the breast. No axillary nodes were palpable. The urine report was negative. Culture from the necrotic tumor area showed no organisms. Serology was negative.

A preoperative diagnosis of carcinoma was made and a radical mastectomy was performed. The patient was discharged on the eighteenth postoperative day.

Pathological report, S-1965, C-5348, (1) medullary carcinoma, (2) tuberculosis of the breast, (3) tuberculous involvement of axillary glands and of glands in the region of the internal mammary artery.

Comment. Approximately twenty-six proven cases of co-existing tuberculosis and carcinoma of the breast had been reported in the literature prior to this study.

Case III. Patient, A. W., No. 169369, a thirty-eight year old female, was admitted with a history of a "lump" in the left breast with very little pain of two months' duration. There was no weight loss. The patient was married for seventeen years and had seven children, the youngest of which was fourteen months old. She had nursed the first four children for the full time but did not nurse the last three. There had been no miscarriages. Menstruation lasted six to seven days, every six to seven weeks, with no pain.

Examination revealed an 8 cm. irregular, hard mass with a sharp, hard edge in the upper, inner and outer quadrant of the left breast. It was well encapsulated under the areola and attached to the skin but not to the pectoral muscle. The nipple was slightly retracted. There were a few soft, axillary glands. The urine was negative. A blood count had not been done. *X*-ray of the chest was negative. No pulmonary pathological condition was demonstrated clinically.

A preoperative diagnosis of carcinoma of the breast was made and a radical mastectomy was performed. The postoperative diagnosis was "probable carcinoma of the breast." The patient's postoperative course was good and she was discharged on the tenth day.

Pathological report, S-2883, cyst, 8 cm. in diameter, lined by a thick layer of granulation tissue and filled with creamy pus. The pectoral muscles were not involved. The axillary nodes had numerous yellow foci. Sections showed tuberculous granulation tissue lining the wall of the cyst with some tubercles and giant cells. Occasionally, there was an atypical overgrowth of the glandular elements. Diagnosis: tuberculosis of the breast.

Case IV. Patient, I. De Z., No. 12979, a twenty-seven year old female was admitted with the history that a bilateral mastectomy had been performed at another hospital one and half years previously. The pathological report was intracanalicular fibro-adenoma of the breast, bilateral, no tuberculosis or malignancy. At this time the patient complained of an ache in the scar of the left breast area with the development of a "lump" in the outer portion of the scar of three weeks' duration.

Examination revealed a small painful, tender area in the left mastectomy scar. The right mastectomy scar was well healed. General examination was negative. Clinical diagnosis was that of abscess or cyst formation in left mastectomy scar.

A preoperative diagnosis of recurrent cystadenoma of the left breast was made. At operation an elliptical incision was made excising the small cystic mass from the site of the previous mastectomy scar.

Pathological report, S-1743, small cystic cavity in an old, well healed scar; lining of soft, friable tissue. Microscopic—cavity lined with a layer of tuberculous granulation tissue. Diagnosis: tuberculosis in scar of a previous mastectomy.

Case V. Patient, H. W., No. 13752, a twenty-nine year old female was admitted with a history of enlargement of the right breast of four weeks' duration with fever and fluctuation of one week's duration. The onset was like that of an acute infection. An incision and drainage had been performed outside of the hospital. Following this procedure the breast became enlarged and glands appeared in the axilla. The patient's temperature rose to 104°F.

A preoperative diagnosis of abscess of the right breast was made. At operation the old incision was spread apart, a large amount of pus was evacuated and a section of tissue was removed for pathologic study. A counter incision was made and gauze packing was inserted. On the first postoperative day the

patient's temperature rose to 104.8°F. A blood culture was negative. The temperature came down by lysis. The patient was discharged on the seventh postoperative day.

Pathological report, S-1994, fatty tissue and lymph glands from the breast; microscopic—acute and chronic inflammation and tuberculous mastitis; epithelioid and giant cells. C-5994, section of granulation tissue—tuberculous mastitis.

The patient was treated with ultra-violet for several months and then multiple sinuses developed which were similarly treated. We have been unable to locate the patient for follow-up study.

Case VI. Patient, I. S., No. 32915, a forty-five years old female was admitted with the following history: She had been admitted on November 11, 1930, with a preoperative diagnosis of a lipoma of the right breast. Operation was performed under local anesthesia and a 3 cm. cyst was excised. The patient was discharged on the following day. Pathological report No. 6690 revealed an inflammatory cyst of the breast; there was no evidence of tuberculosis.

On November 21, 1930, the patient was readmitted because of non-healing of the wound. *X*-ray of the chest showed no bone disorder but old fibrotic lesions in the apices and first interspace on the left side. The wound was irrigated and strapped. The patient was discharged on December 4, 1930.

On December 15, 1930, the patient was readmitted because the wound was not healing. The wound was resutured and drained. By December 26th the wound still had not healed. On January 13, 1931, a preoperative diagnosis of non-healing right breast wound was made. At operation the sinus was probed and opened wide. This ran to the cartilage of the eighth rib where a caseous area the size of a dime was found. This was curetted. The wound was sutured and drained. Pathological report, No. 6954, sinus wall—tuberculosis. The patient was discharged on February 25, 1931.

On May 11, 1931, the patient was readmitted for a fracture of the shaft of the right humerus. Examination of the breast at that time revealed that there was still a granulating sinus in the right breast region. The fracture of the arm healed; good callous formation took place. The patient was discharged on July 28, 1931.

On October 26, 1931, the wound has finally healed after alpine light therapy two to three times a week. A four year follow-up revealed the wound to be well healed; there has been no recurrence.

Case VII. Patient, E. R., No. 84305, a thirty-six year old female was admitted on January 3, 1935, with a history of a mass in the left breast of four months' duration. It was painless and non-tender. There was no history of tuberculosis in the family and no pulmonary symptoms. The patient had two children.

Examination revealed a firm mass, plum size in the lower inner quadrant of the left breast. It was freely moveable within the breast but attached to the underlying seventh and eighth ribs at the chondrosternal articulation. *X*-ray of the lungs was negative. Urine and blood serology was negative. Blood count was as follows: hemoglobin 70, red blood count, 4,480,000, white blood count, 8,700, polymorphonuclears, 58, eosinophiles, 5, lymphocytes, 32, mononuclears, 5.

A preoperative diagnosis of osteochondroma was made. At operation January 5th the mass was found to be an abscess cavity which was excised after it had been inadvertently opened. Creamy white pus exuded, which on culture was sterile; guinea pig inoculation was positive for tuberculosis.

Pathological report, No. 13113, cyst; microscopic—granulation tissue in which were numerous tubercles.

The patient was discharged on the ninth postoperative day with the wound healing.

The patient was readmitted on September 27, 1937, for the repair of a ventral hernia which was at the site of the cesarean sections performed five and six years previously. There was also present a draining sinus of the left breast of eight weeks' duration. The patient had been treated with *x*-ray therapy. Two years and seven months after the operation the wound broke down. Examination revealed a sinus attached by fibrous tissue to the deep fascia or to the ribs.

On September 28th, the ventral hernia was repaired and the breast sinus curetted. The sinus was found to be ¾ of an inch deep. The wall was curetted and iodoform packing inserted. The curettings were not sent to the laboratory. *X*-ray of the chest and ribs was negative. On January 13, 1938, the sinus was healed.

On July 8, 1940, the patient was readmitted because of kidney symptoms. She had frequency, nocturia and burning of eight months' duration. She had lost sixteen pounds in the past eight months. Urologic work-up revealed renal tuberculosis on the left side. This was confirmed by guinea pig inoculation.

The old breast scar was well healed; there had been no recurrence.

Case VIII. Patient, J. G. W.,* No. 83487, a twenty-three year old male was admitted on April 4, 1938, with a history of swelling of the right breast of five weeks' duration. It was painless until the day before admission. The patient had a past history of tuberculosis of the right knee for which a synovectomy and meniscectomy had been performed in June, 1934. The patient was readmitted to the hospital from April to December, 1935, during which time an arthrodesis of the right knee was performed. At a later date an incision and drainage was also done. The right lower extremity had to be amputated above the knee which was followed by a disarticulation at the hip. In June, 1936, the patient was readmitted for one day for dressing of the stump which had become infected. The patient became an artificial limb salesman.

Examination revealed a diffuse enlargement of the right breast which was slightly tender and fluctuant. The mass seemed to be attached to the fourth rib at the costosternal junction. Tenderness was also present when firm pressure was made on the subjacent rib. The nipple was not involved.

A preoperative diagnosis of tuberculous mastitis was made. Aspiration yielded pus tinged with blood which on examination revealed many polymorphonuclears and moderate lymphocytes. The culture was sterile after forty-eight hours. Guinea pig inoculation was positive for tuberculosis. Tuberlin test was positive 1–100 to 1–10,000. The sedimentation rate was 17 mm. The blood count was normal. *X*-rays of the lungs and ribs were negative.

The patient was discharged to a convalescent home for conservative therapy which consisted of repeated aspirations, ultra-violet and infrared therapy. The patient remained at the home from April 19, 1938 to October 14, 1938. On discharge the condition appeared apparently arrested. There was no external evidence of disease and *x*-rays of the ribs showed no bone involvement.

The patient was readmitted to the hospital on May 25, 1940 because of tuberculous epididymitis and seminal vesiculitis. Urine examination and guinea pig inoculation were positive for tuberculosis. A left epididymo-orchectomy was performed. Pathological report revealed tuberculosis.

Physical examination of the right breast at that time revealed no apparent disorder. The patient was discharged on June 15, 1940.

Case IX. Patient, A. F., No. 91352, a forty year old female, was admitted with a history of heaviness of the left breast of five months' duration, and draining sinuses in the left axilla of one year's duration. Fifteen months prior to admission (in June 1940) the patient had a painful red swelling in the left axilla but no discharge. Three months later an incision and drainage was performed in the out-patient department of another hospital. The wound healed after seven months of home treatment. In April, 1941, the discharge reappeared in the left axillary wound. An incision and drainage was performed by a local medical doctor under novocaine anesthesia. The wound did not heal after several months of treatment and the patient came to the out-patient department of this hospital and was admitted for treatment on August 28, 1941.

The patient was born in Puerto Rico and had been in this country for fifteen years. She was married and had two children, ten and seven years of age, bottle fed.

Examination revealed the left breast to be thick and indurated. There were discharging sinuses in the left axilla and healed scars in the left cervical region. Sedimentation rate was 63 mm. Blood and urine examinations were normal. *X*-ray of the chest was negative. Tuberculin test was positive, 1–10,000. Smears made from the pus on August 30, 1941, revealed no tubercle bacilli. Guinea pig inoculation was done. On September 5th smear and culture from the wound revealed streptococci in twenty-four hours, and actinomycoses in one week. There was also polymorphonuclears, gram-positive cocci and filaments. On September 20th an incision, drainage and biopsy of the sinus bearing area was performed revealing granulomatous infiltration of the breast. Micro-

* The authors are grateful to Dr. Leo Mayer for permission to use this case.

scopic findings were reported consistent with the diagnosis of actinomycosis. Smear showed gram-positive filaments. Culture showed gram-positive and negative aerobic bacilli; staphylococcus and streptococcus anhaemolyticus; actinomycosis at twelve days. The pathological report of biopsy revealed chronically inflamed granulation tissue, giant cells and areas of necrosis. There were granulomatous nodules with purulent centers.

Postoperatively there was profuse, purulent discharge from the sinuses in the indurated left breast. The patient was given ultra-violet treatment for eight days, from September 5th to the 13th. On September 20th sodium iodide was begun but stopped on September 26th when the diagnosis of actinomycosis was made; 5 Gm. of sulfathiazole powder suspended in peroxide were instilled into the wound daily for twelve days. On September 30th, *x*-ray therapy was started.

The patient had been treated for actinomycosis on the basis of cultures reported on September 5th and September 20th and biopsy report of September 20th. However, on October 10th the guinea pig which had been inoculated with the pus taken from the discharging sinus on August 8th was autopsied and found to have tuberculosis.

The follow-up study revealed that the patient had been receiving cold quartz and heliotherapy to the left breast and when she was last seen on April 27, 1942, there was a granulating area 4 by 4 mm. in the left breast.

SUMMARY

1. Nine cases of tuberculosis of the breast have been presented including two cases with co-existing carcinoma.

2. The need for guinea pig inoculation in addition to the usual bacteriologic study of chronic discharging breast sinuses is suggested.

3. For the proper surgical management of all suspicious breast lesions, we believe that the use of the frozen section is essential.

4. In only two of our nine cases was the diagnosis suspected preoperatively; one of these patients had chronic discharging sinuses and one had previous joint tuberculosis.

CONCLUSION

In our experience with tuberculosis of the breast, we have been unable to make a clinical diagnosis with any reasonable degree of frequency.

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CHOLECYSTITIS*

THE ADVANTAGES OF OPERATIVE TREATMENT IN DEFINITE UNMISTAKABLE DISEASE

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SURGICAL conditions of frequent occurrence warrant periodical reviews. Cholecystitis is an example regularly encountered by general surgeons in all hospitals. Practical values require that such a review contain only recent cases. To consider results of ten years ago together with those of today would not make for a fair comparison. This is so because of the recent improvements in anesthesia, increased knowledge of nutrition, fluid balance and the use of chemotherapy. Accordingly only a recent three-year review will be considered. This period extends from June, 1940, to June, 1943. These cases are from one surgical division representing approximately one-half of the patients with gallbladder disease who entered St. Vincent's Hospital in that given time. One hundred fifty-one cases comprise the group. These patients were subjected to surgery by a rotating group of nine operators.

It has long been our policy to be most rigid in the selection of patients for operation. We have tried as far as possible to operate upon patients with definite unmistakable disease. This is borne out by the fact that 114, or more than 75 per cent, of the patients had gallstones. This is in strict accordance with accepted modern surgical consideration of cholecystitis.[1–4] In 1931, Stuart and Timoney,[5] in an unpublished report, showed the following: In non-calculus cholecystitis the rate of cure was only 42 per cent; in cases with stones the rate of cure rose to 77 per cent. They further showed that patients with gallstones obtained good results following either cholecystectomy or cholecystostomy. This indicated that satisfactory results depended more upon positive disease than upon the type of operation performed.

Cole[6] estimates the incidence of cholelithiasis in most clinics as hovering around 50 per cent. He cites Heyd reporting 59 per cent and Deaver 50 per cent. Cole also states that 8 per cent of all cases of cholecystitis in hospitals are acute. In our present series, thirty-five or 23.17 per cent were either acute or subacute. This increase over the low figure of 8 per cent is largely due to an active ambulance service in a hospital where many acute and emergency cases are admitted. Operations performed on patients with acute cholecystitis is an added assurance of dealing with definite and unmistakable disease. We agree with Gray[4] that the history of an acute attack alone is not sufficient reason for cholecystectomy. Definite pathological change must be present. We firmly believe that operation should be performed only for gallstones or proved disease. Cholecystectomy performed in border-line cases or where disease is non-existent, carries an endless chain of distressing digestive symptoms. This is referred to as post-cholecystectomy syndrome or reflex biliary dyskinesia. The treatment of this symptom complex is unsatisfactory, attended with only limited results. From their studies, Goldman and Bell[7] state that "the removal of the stoneless gallbladder may not only be without benefit but may be harmful."

As will be shown it is a disease of late middle life. The increased life expectancy, the increased age of our population and the

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increased accuracy of diagnosis may reasonably lead us to expect to encounter more and more cases. In their comprehensive review of gallbladder surgery, Brooks and Wyatt[8] state that improvement in treatment and the lessening of mortality in gallbladder disease should be more generally recognized. As a measure toward increasing life expectancy during the past fifty years, it ranks with the reduction of infant mortality and the improved treatment of tuberculosis. In the later years of their series these authors had performed 245 consecutive cholecystectomies without a death—a splendid record. In a study of carcinoma of the gallbladder Lam[9] cites Graham, who stated that the incidence of cancer developing in gallbladders with stones would exceed by far the 1 to 3 per cent usual operative mortality for gallbladders with stones. Lam also emphasizes the comparatively hopeless prognosis in carcinoma of the gallbladder. Lichtenstein and Tannenbaum[10] in carcinoma of the gallbladder report the incidence of stone as being 69 per cent of their seventy-five studied cases. From these studies one might reasonably conclude that a stone in the gallbladder is a predisposing factor in the production of cancer in this organ. This would further increase the value of the operative treatment of cholelithiasis.

Sex. Of the 151 cases studied, ninety were female and sixty-one male. This 3 to 2 ratio is considerably different from the usually given 3 or 4 to 1 ratio.

Age. Many ages were represented as shown in the following table:

TABLE 1
151 CASES OF CHOLECYSTITIS

Age Group	20–30 years	30–40 years	40–50 years	50–60 years	60–70 years	70– years
No. of patients	11	40	38	37	21	4
Percentage	7.21	26.4	25.1	24.5	13.9	2.6

Diagnosis. A reasonably high degree of diagnostic accuracy was obtained. The diagnosis was correct in 144 or all but seven cases. This can be attributed to certain factors, viz., roentgenographic evidence of stone, repeated non-filling of the gallbladder during cholecystography, or the history with symptoms and definite physical signs of an acute attack. A wrong or inaccurate diagnosis was obtained in the seven cases as follows:

1. Undetermined. Various possibilities were considered before operation. At exploration, gall-stones were encountered.
2. Diseased gallbladder removed coincidental to gastrectomy for gastric ulcer.
3. Gastric ulcer. Gallstones were found and the gallbladder removed. Deformity of stomach was caused by an adhesion.
4. Carcinoma of gallbladder. Patient, female, sixty-six years of age, had stones of long-standing, loss of weight, leucocytosis. May also have had tabes dorsalis. Gallbladder was removed and a widely dilated common duct drained. Outcome was fatal.
5. Undetermined. Preoperative *x*-ray showed a calcified mass which appeared to be outside the gallbladder. The nature of this calcified mass was undetermined. At operation a gallstone in the very redundant fundus of the gallbladder was encountered.
6. Acute appendicitis.
7. Acute appendicitis.

In cases two and four, gallstones were recognized on roentgen films but were not considered causative of the symptoms noted. Thus, these two cases are listed among the errors of diagnosis because operation was not primarily performed for the removal of gallstones.

Treatment. The 151 patients were treated as follows:

Cholecystectomy (alone)	125
Cholecystectomy with choledochostomy	9
Cholecystectomy with gastrectomy	2
Cholecystectomy with gastroenterostomy	1
Cholecystectomies	137
Cholecystostomies	14
Total number of cases	151

Cholecystectomy was the operation of choice in more than 90 per cent of cases. Of the fourteen patients subjected to cholecystostomy, there were no deaths. Eight cases were acute and six were chronic. Eleven of the gallbladders drained contained stones. Three were stoneless. The number of cases of drainage of the gallbladder is so small as to allow no special consideration. We also are of the generally accepted opinion that cholecystectomy is the operation of choice.

Nine, or 6 per cent, of our patients required drainage of the common duct. Enthusiasm for exploration of the common duct should be tempered and guided by indications present. The outstanding indications for common duct drainage are palpation of stones, history of jaundice, multiple small stones in the gallbladder with a dilated cystic duct, dilatation of the common duct and enlargement of the head of the pancreas. Goldman and Bell[7] drained the common duct in 20 per cent of all cases, and of these found stones in only 11 per cent. They state that as a result of this enthusiasm for draining the common duct, they have encountered many cases with ductal stricture and biliary fistulas. We agree that in cases of common duct drainage cholangiograms should be taken at the time of operation. Thus an occasional stone in the biliary tree that might be overlooked at operation may be found.

The operation of cholecystectomy is not without risk. Good results are more attributable to the skill of the operator than to any other factor. This competence of the surgeon is stressed by Strelinger[11] and by Brooks and Wyatt.[8] They state that the skill of the operator counts more than knowledge of water balance, carbohydrate reserve, etc.

Complications were frequent, occurring in twenty-eight or 18.5 per cent of cases.

Complications:

Postoperative pneumonia	8
Pulmonary atelectasis	9
Pulmonary atelectasis with massive collapse and lues	1 (fatal)
Postoperative bronchitis	2
Subphrenic abscess	1
Subphrenic abscess with secondary pyopneumothorax	1
Cardiac decompensation—postoperative autopsy	1 (fatal)
Femoral phlebitis with pulmonary embolism	1
Generalized peritonitis. While sleeping the patient pulled the T-tube from the common duct seven days after operation. *X*-ray showed signs of subphrenic space abscess	1 (fatal)
Postoperative stenosis of common duct	1 (fatal)
Biliary fistula	1
Incomplete intestinal obstruction	1
Total	28

Of these complications at least twenty were pulmonary in origin. We believe that today the timely use of sulfonamide therapy would either prevent the occurrence or lessen the severity of many pulmonary complications. It might also be stated that the increasingly frequent use of the oblique subcostal and transverse incisions will further contribute to the reduction of pulmonary complications. In four instances complications contributed to fatalities. Russo,[12] in his gallbladder review, mentions cardiac, accidental and other factors in the cause of death.

Results. Of 151 cases reviewed there were six fatalities or a mortality of 4 per cent.

Mortalities:

1. Case No. 24014. A male, fifty-seven years old, had a cholecystectomy performed for cholelithiasis. Postoperative pulmonary atelectasis developed and no sulfonamides were given.

2. Case No. 24089. A male, seventy-one years old, had a cholecystectomy for cholelithiasis. He died of postoperative shock and bronchopneumonia.

3. Case No. 13450. A female, aged fifty-eight, underwent cholecystectomy for cholelithiasis. She died from pulmonary edema secondary to cardiac decompensation as proved by autopsy.

4. Case No. 32207. A male, aged forty-nine, underwent cholecystectomy and choledochestomy for cholelithiasis. Seven

days postoperatively, the T-tube was found outside the dressing. Death occurred sixteen days postoperatively, with signs of generalized peritonitis and *x*-ray evidences of a subphrenic abscess.

5. Case No. 20983. A female, forty-seven years old, at the primary operation had a cholecystectomy performed for chronic cholecystitis without stones. She developed postoperative stenosis of the common duct with biliary fistula. At the secondary operation, hepatico-duodenostomy was performed over a rubber tube. The patient passed the tube a few weeks after operation. At the third operation hepaticostomy was performed. The patient died of shock and exhaustion.

6. Case No. 11306. A female, aged forty-seven, had cholecystectomy and choledoctostomy for gallstones and marked dilatation of the common duct. She had lues and developed massive collapse of the right lung.

If we eliminate the two cases of primary choledochostomy with cholecystectomy, the mortality for chronic cholecystitis as such would be reduced to four cases or 2.6 per cent. Cardiac disease contributed to fatality in one case, accidental injury to the common duct in another case, and in the other two cases pulmonary atelectasis and shock together with bronchopneumonia.

SUMMARY

One hundred fifty-one cases of gallbladder disease are reviewed. These are the patients treated by the First Surgical Division Staff at St. Vincent's Hospital in a three-year period. The incidence of stone in the gallbladder was 75 per cent. The total operative mortality for all cases was 4 per cent. The operative mortality for chronic cholecystitis alone was 2.6 per cent.

CONCLUSIONS

Operations performed in the presence of definite unmistakable gallbladder disease give assurance of increased satisfactory results. This is accomplished by more strictly limiting the indications for operation. The presence of gallstones, or the history or presence of an acute attack, make reasonably certain the indications for operation. The operative mortality for definite unmistakable gallbladder disease can be kept to a reasonably low figure.

The author wishes to thank Dr. Gerald F. O'Brien for his help in compiling statistics.

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CLOTHESPIN GRAFT OF THE SPINE FOR SPONDYLOLISTHESIS AND LAMINAL DEFECTS*

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BECAUSE of the difficulty in securing a satisfactorily high percentage of arthrodesis on attempting to repair laminal defects, bridge spondylolisthesis defects, or secure fusions to include more than one lumbar segment to the sacrum, improvement of graft technic was attempted. Fixation of tibial grafts to spinous processes with vitallium screws proved unsatisfactory. The screws worked loose, the grafts became displaced, and absorption of grafted material occurred. It was thought that if graft placement could be solidly maintained by the shape of the graft alone, without other fixation, results could be improved. At first an inclusion graft was tried, encircling the spinous processes of lumbar 4, lumbar 5 and sacral 1 and was satisfactory. Because of the structural weakness of the graft so cut, the clothespin (or "H") graft was devised.

This consisted of a graft with the ends notched out to receive spinous processes at either end of the fusion area. It is placed with the patient in flexion and the spinous processes separated. The patient then being extended, it is maintained firmly in position. Separation of the posterior elements was not only found to occur due to the leverage action of the graft but of the anterior elements as well. (Fig. 1.) Intervertebral foraminae of the graft area were definitely enlarged by the distraction. In cases of spondylolisthesis, apparent reduction of the body which had slipped was secured. The word "apparent" is used since actual replacement did not occur but a certain amount of derotation of the slipped body was obtained. Not only in theory but also in clinical experience decompression of nerve roots and immediate relief of pressure pain were normally secured. Tibial bone was used at first for graft substance but later massive iliac bone grafts have been used. The above fusions were reinforced with separate iliac strips in all but a few cases. (Fig. 2.) The rigidity of fixation resulting from the method of implantation of the main graft has held the extra iliac strips placed underneath in excellent contact with the posterior elements of the vertebrae. At least two other surgeons have used the procedure independently of us. The following will be an attempt to make an early analysis of certain results, difficulties and complications.

There have been seventy-seven such grafts done with but one mortality, this occurring seventy-two hours postoperatively. It was reported as delayed shock. During the operative procedure the dura was opened unintentionally on two occasions with small pin-prick openings. No symptomatic sequelae ensued. Mild shock was encountered in several instances and moderate shock on three occasions. There have been few recent cases of shock since we have routinely begun to use infusion of saline and glucose at the beginning of the operation. We would strongly urge that this always be done. In half of the cases two surgical teams were used with marked reduction in operative time. Such use of a second team will, of course, be impracticable where clothespins are fashioned of massive iliac grafts. As the surgeon ac-

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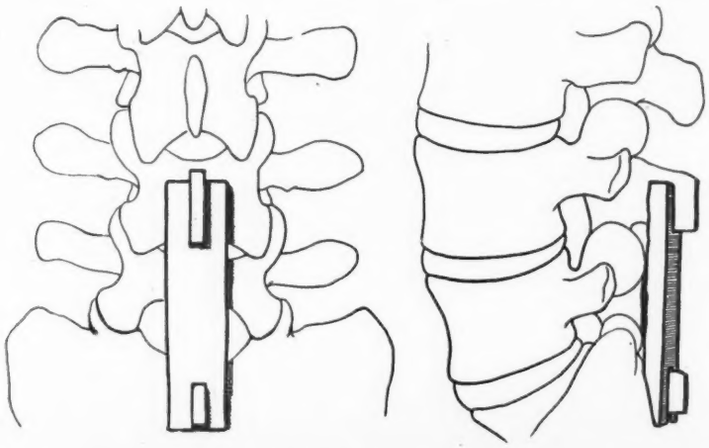
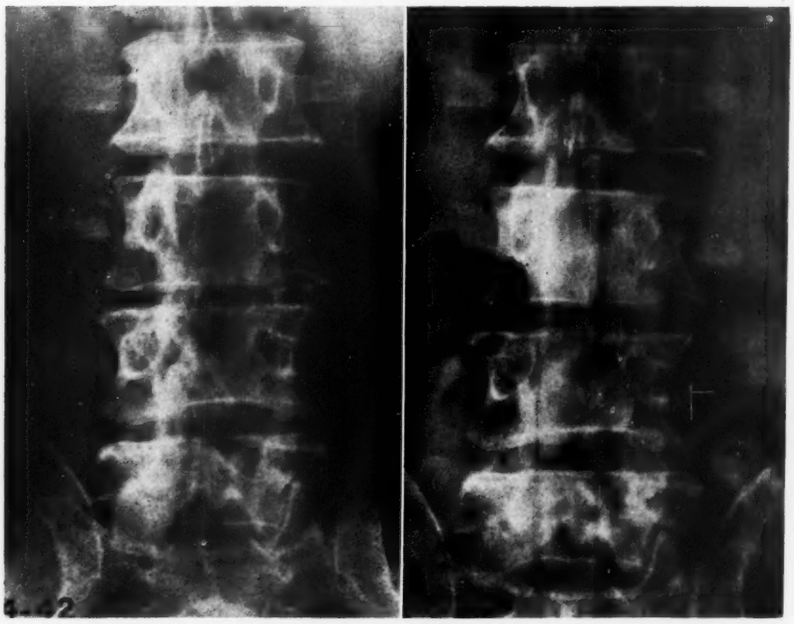
quires skill in the procedure he can dispense with the second team and still hold down his operative time. Transtively. Stability of the graft at operation has routinely been good. As a matter of fact, the main grafts are so firmly wedged



A



B

FIG. 1. A and B, double clothespin graft has great strength, is firmly maintained in position when applied with the spine in flexion and then extended to normal, and provides a distracting force to separate intervertebral spaces as well as secure fusion. Note the opening of the third lumbar intervertebral space and separation of left fifth lumbar first sacral articular facet caused by long clothespin graft as shown in *x*-ray.

fusions planned in advance have been used on two occasions and plasma once. Fracture of one prong of a graft occurred during operation in one instance. In one other instance it occurred postoperatively. No fracture of the body of a graft has occurred either at operation or postoperain place that following extension of the patient they can be grasped and the patient's whole lower spine and pelvis shaken without any displacement of the graft. The strength of the spinous processes has always determined the mechanical stability of the grafted area.

There have been four postoperative infections. Two were due to hematoma, one due to silk suture in deep fascia and tibia at the site of ostectomy occurred in four instances at seven, five, four and one months postoperatively. (Fig. 3.) This

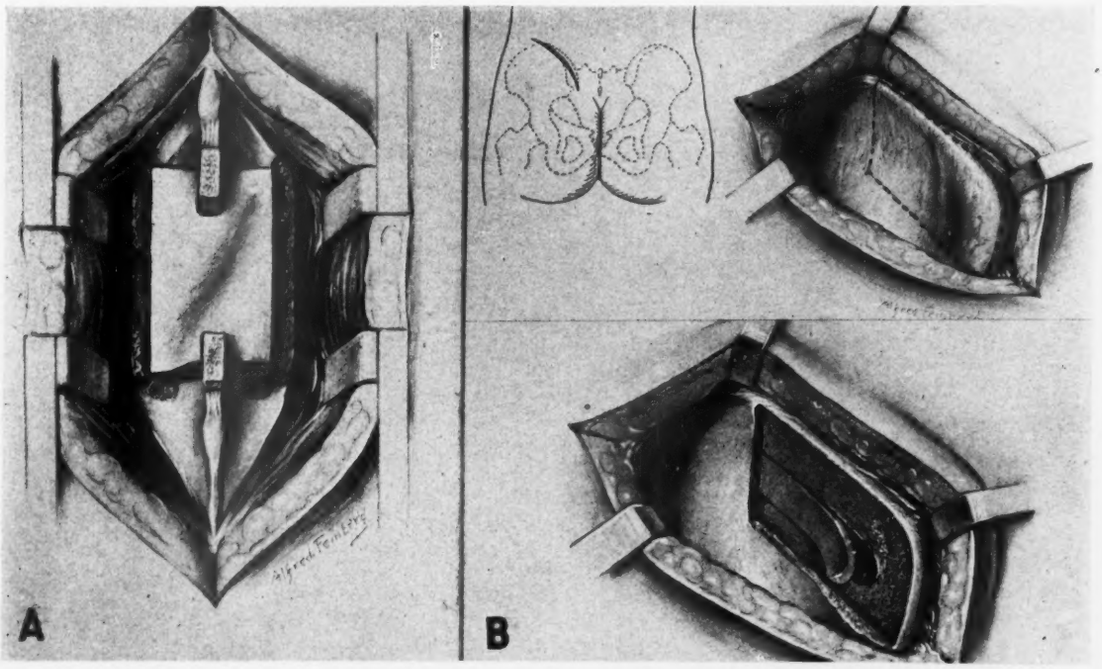


Fig. 2. A, double clothespin graft fashioned of massive iliac bone re-enforced with iliac strips. B, site of iliac incision and outline of massive iliac graft used for clothespin as well as cancellous iliac strip being removed.

one frankly operative. Two of these patients promptly lost their main grafts following the infection, but the others healed without further incident. There have been two grafts removed for aseptic necrosis, with negative cultures and primary healing followed the removal. One of these patients was re-grafted with iliac strips at the same operation at which the tibial graft was removed. Of the sixty cases in which tibial bone was used there have been four tibial hematomas, all at present healed. Among the fifty-four cases in which incisions were used for iliac bone there has been only one hematoma. Tourniquets were used in the first forty-six cases for removal of tibial grafts with the occurrence of thrombophlebitis of severe amount on two occasions and complete peroneal palsy on two occasions. All four patients recovered though with some amount of residual damage after thrombophlebitis. Spontaneous fracture of the happened in three instances in spite of the prolonged use of crutches. All four fractures are satisfactorily united and enjoy complete weight-bearing at the present time without appreciable deformity. Replacement of the graft with a second clothespin has been done in one instance and with iliac strips in one other case. Two of the patients who lost their main tibial grafts are healed and solid due to the iliac strips laid along the lateral margins of the posterior vertebral elements at the original operation. In three instances the spinous process abutment on the sacrum has been dislodged by graft pressure at some time postoperatively as shown by *x*-ray findings. Two of these cases successfully united the graft to the sacrum despite the sliding displacement. A sulfa drug was implanted in a few instances but this practice discontinued. In addition to the above complications, there was one upper respiratory infection, one temporary

bladder and rectal retention, two mild postoperative cases of ileus, one pyelonephritis in a patient with a previous

The average time of operation was one hour and ten minutes, though it varied from forty to 150 minutes depending upon

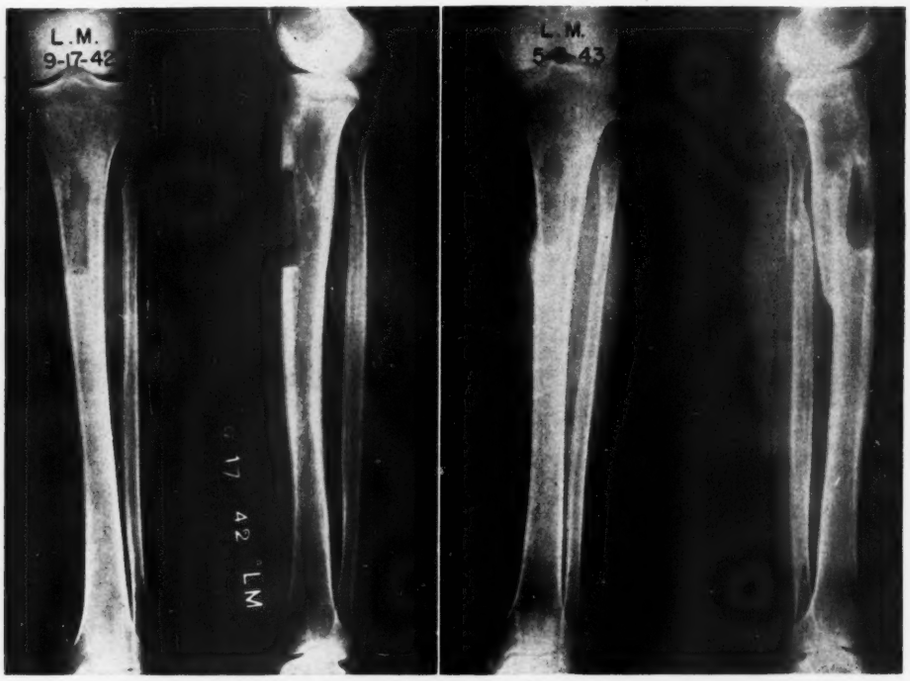


FIG. 3. Pathological fracture of the tibia may occur as late as seven months postostectomy. The above occurred four months postoperatively, and was solidly united four months later. Such occurrences may occasionally have to be accepted where strength of tibial bone is needed for distraction. They can be avoided in other cases by using a massive double clothespin iliac graft.

prostatitis, an incident of appendectomy two days post-spinal fusion, and one patient became pregnant a month and a half following spinal fusion, a process which evidently did the graft situation no good.

Among the present series of patients submitted to the above procedure many other pathological lesions were found outside of the spinal area. Frequently present were obesity, cardiovascular disease, pelvic inflammatory conditions, prostatitis and hydrocele, gastrointestinal lesions, kidney disease or ptosis, chronic alcoholism, shell-shock, tuberculous glands, lues, hernias and anemia. These conditions frequently contributed to complications which arose.

The time of hospitalization varied from a low of twelve days to a high of four months. The usual time of hospitalization in the uncomplicated case was three weeks.

the difficulty of exploration for disc herniation. In one instance the operative time was 240 minutes when massive exploration and removal of a tumor was done by an associated neurosurgeon. In the early cases plaster jackets were applied immediately postoperatively. In all recent cases the fixation of the graft has been found to be so firm that the plaster support may be delayed for postoperative recovery. The jacket is now generally applied two and one-half weeks postoperatively. The patient with tibial ostectomy is allowed up on crutches at three weeks and continues on crutches for six weeks thereafter. Where the massive graft has been fashioned of iliac bone, the patient is made ambulatory immediately following cast application. An occasional patient has been kept recumbent up to a period of four months postoperatively. These are instances in which patients have had extensive spinal

work previously with the presence of pseudoarthroses, scarred operative sites, and extensive symptomatology.

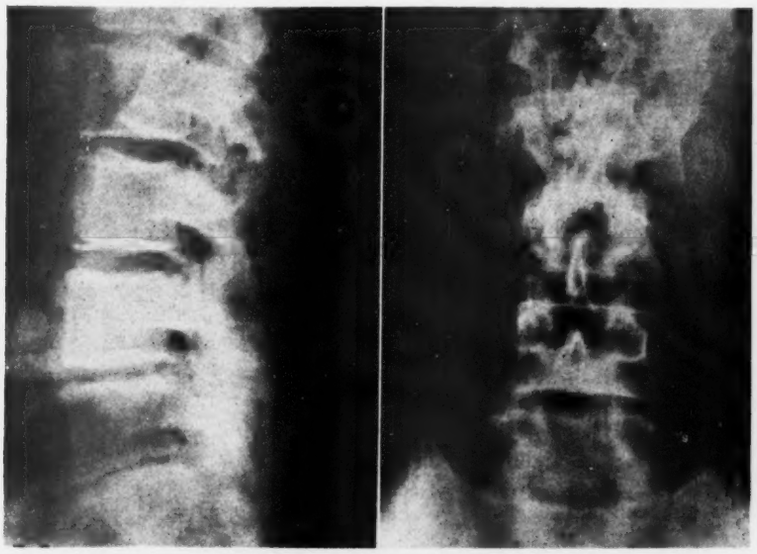


Fig. 4. The only sure proof of complete arthrodesis is the accurate superimposition of the fused segments in *x*-rays taken in flexion and extension, and in right and left lateral flexion. Note that the bodies of lumbar four to sacrum in the above *x*-rays accurately superimpose and that spinal motion begins at lumbar three. In the anteroposterior view due to rotation of the patient the graft itself may not accurately superimpose but in these cases the margins of the graft are parallel.

The type of graft used has included one inclusion graft, sixty-six double clothespin grafts, eight single clothespin grafts and two angulated strut grafts. The single clothespin grafts have been applied where fusion has previously been solidly secured but its extent upward is desired. These grafts then enclose the spinous process at the upper limit of the new fusion area desired and abut in a transverse groove cut in the previous fusion area. The double strut or angulated grafts have been used on two occasions for spondylolisthesis where there was complete associated spina bifida of all the sacral segments. These strut grafts are placed from the fourth lumbar spinous process to grooves cut transversely in the articular facet region of the first sacral segment. They are essentially single clothespin grafts placed in pairs. On three occasions double clothespin grafts have been used with a long slot in one end to include two or more spinous processes. In two instances single clothespin grafts have been placed to include two segments above a previous fusion and in these instances the intervening spinous process has been left in situ and passed through a hole cut in the clothespin graft. Sixty-three of the grafts have been fashioned from tibial bone and fourteen from massive sections of iliac bone. Where strength is desired and distraction of vertebral segments essential, tibial bone has been considered mandatory. Where only one intervertebral space is to be crossed and separation of the vertebrae is not essential, iliac bone is satisfactory for the main graft, more easily and safely obtained and more rapidly reossified. In all but ten instances the massive clothespin graft has been reinforced with additional strips of iliac bone. This has been done to secure a more rapid osteogenesis and more rapid fusion than would be obtained with the more densely sclerotic tibial strut. As will be shown later, results are more satisfactory when such strips are added to clothespin grafts. In order to satisfy ourselves on this point we ran a series of ten operations in which nothing but the

massive tibial clothespin graft was used. Though the percentage of final union in these cases was almost as good as in the whole series, the length of time to secure solid arthrodesis was much greater.

The area grafted varied considerably. There were thirteen cases with fusion from lumbar 3 to sacrum, forty-six from lumbar 4 to sacrum, and seven from lumbar 5 to sacrum. Single instances of arthrodesis of individual spaces or combination of spaces between lumbar 2 and sacrum were numerous. The basic conditions for which operation was performed were:

	No. of Cases
Spondylolisthesis	11
Posterior herniation of the intervertebral disc	32
Laceration of the intervertebral disc without posterior protrusion (included among these are two probable cases of tuberculosis)	8
Lumbosacral strain (associated Schmorl's nodes and dural adhesions included)	20
Spinal cord tumor (neurosurgical associate operating)	1
Old extensive laminectomy defects	3
Pseudarthrosis of previous spine fusion	2

Among the cases of posterior herniation of the intervertebral disc there were twenty-two with typical coiled-up nuclear material, eight with so-called organized chondromatous masses of unquestionable origin, and two with calcified herniated material. One of these two calcified discs included a patient with a calcific mass the size of a small marble directly under a nerve root, pressing it against the adjacent articular facet surface. The other was a calcified chondromatous mass. It is interesting to note that preoperatively eleven other cases were diagnosed as posterior herniation of the intervertebral disc when no definite disc mass could be found. Thus our percentage of absolutely accurate preoperative diagnosis of disc herniation is 66⅔ per cent correct in this series. As the series advanced the accuracy of diagnosis was noted to have improved.

Laminectomies were associated or antedated the clothespin graft fusion as follows: There were sixteen fresh (hemi or total) laminectomies of a vertebral segment accompanying the spine fusion. Most of these occurred among the first nineteen patients. There were three preexisting old laminectomies associated with the pathology and symptomatology for which the present fusion operation was done. In twenty-five instances the lower or upper margin of a laminal arch was slightly rongeured to further the exploration for suspected herniation of intervertebral disc. Among the eleven cases of spondylolisthesis included in this series, eight had such extensive posterior displacement of the fifth laminal arch that a straight clothespin graft could not be laid without entire removal of this loose vertebral fragment. Four trisacral fusions for low back symptomatology had previously been performed, were found solid, and were added to. In addition there were two old extensive fusions with pseudarthroses upon which we implanted new tibial clothespin grafts reinforced with iliac bone. The repair of these patients and those with old laminectomy defects were difficult.

RESULTS

Fifty-five patients were operated upon before January, 1943. Since casts are not removed for five months postoperatively the question of solidity could not be determined later than that date. Our result statistics are therefore limited to these fifty-five cases.

Though we believe that clinical estimation of solidity of spinal fusion is unsatisfactory, the records show an estimated forty-nine cases (89 per cent) solid. One patient is being treated elsewhere. Four cases were clinical failures. We believe the only *accurate* method of determining solid spinal fusion is by flexion and extension *x*-rays. When such *x*-rays are superimposed and no motion whatever is shown we believe that solid ankylosis can be granted. (Fig. 4.) Superimposed right and left lateral flexion *x*-rays are an additional safeguard; forty-one of the cases have been checked with these motion *x*-rays;

thirty-three of them (83.3 per cent) are completely solid, the *x*-rays accurately superimpose, and no motion can be demonstrated. In six (14.6 per cent) there is motion demonstrable and failure of synostosis is therefore accepted as present. Two cases (4.9 per cent) almost superimpose in the flexion and extension views and are probably solid, the slight change being accounted for by rotation of the patient in taking the *x*-rays. If these were included, the patients with solid union would be 88 per cent of the series.

There were eleven instances of spondylolisthesis. One is too recent to report. Of the other ten, nine were of lumbar 5 and one of the fourth lumbar; eight are proved solid (80 per cent) by *x*-rays as denoted above. One case has questionable slight motion on superimposed lateral *x*-rays. All of the patients have complete stability and relief of preoperative symptomatology except for one proven failure.

Of the entire series all patients had entire clinical relief except four who were partially relieved and four unrelieved. It will be noted that two of the six patients with pseudarthroses have partial relief of their preoperative symptomatology. The definite known failures included two cases of posterior herniation of the intervertebral disc, one of lumbosacral strain, one of spondylolisthesis, one old laminectomy defect and one old long multiple chip graft fusion with pseudarthroses throughout.

The series was analyzed in an attempt to determine the cause of failure. Among the six patients with pseudarthroses there were two in whom no extra bone outside the massive tibial graft was used, two who avulsed a small insecure first sacral spinous process, and two in whom no known cause of failure could be determined.

CONCLUSIONS

1. Where the stability and strength of tibial bone is not essential, the massive graft may be made of iliac bone to avoid occasional postoperative hematoma and infection of the tibial wound and the possibility of tibial fracture which exists for several months.

2. Infusion with glucose and saline should accompany, not follow, the operative procedure. Addition of transfusion at operation is now routine.

3. Grafts should always be reinforced with iliac strips.

4. For accurate estimation of spinal fusion *x*-rays in flexion and extension and right and left lateral flexion must superimpose.

CONIZATION AND EARLY DIAGNOSIS OF CARCINOMA OF THE CERVIX*

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CARCINOMA of the cervix is the most common malignant lesion in the female. Twenty-seven to 30 per cent (Martzloff, Welch, and Orth) of all carcinomas in the female are uterine carcinomas of which 80 to 97 per cent (Koblanck, Backer, Blumenfeld) originate in the cervix. Therefore, we understand the great attention paid to the problems of diagnosis and treatment of this particular type of carcinoma. The early diagnosis of the beginning carcinomatous lesion of the cervix is absolutely essential for its successful treatment.

The tragedy of cervical carcinoma lies in the fact that the patient is frequently not seen until the malignancy is already far advanced. It is usually only in the advanced stages of carcinoma that definite symptoms are manifest, i.e., a bloody vaginal discharge and a history of hemorrhage on contact, such as that following vaginal examination or coitus. Pain is a late symptom and usually occurs after the cancer has already spread to the peritoneum and to the pelvic connective tissue which has a rich nerve supply. As a rule, few if any subjective symptoms are present during the early stage of this disease.

There are probably two reasons why early carcinoma of the cervix is discovered late: (1) The patient is not likely to seek medical advice unless symptoms are present. (2) The examining physician may overlook early malignancy or mistake it for a benign lesion.

The most certain way of diagnosing early carcinoma of the cervix is by biopsy. There are various accepted diagnostic procedures but none of them are completely satisfactory. The positive Schiller test is not absolute proof of malignancy. According to Meyer, the correct diagnosis in 60 per cent of cases of carcinoma of the cervix would be missed by this test. Martzloff points out that the overwhelming majority of unstained areas shows no histological evidence of beginning cancer. Schiller, himself, states that his test is of no value at all in differentiating ulcerating carcinoma and erosion, and suggests biopsy in cervical lesions.

In an experimental check-up for cancer made by McFarlane, Fetterman and Sturgis on 1,000 supposedly well women, thirty years of age and over, 4 malignancies of the uterus and 357 benign lesions of the cervix were found by performing biopsies. Schmitz reports fifteen silent carcinomas that were discovered accidentally on histological examination of cervical tissue following amputation of the cervix for extensive cervicitis, in a series of cases of primary carcinoma of the cervix observed between the years 1915 to 1931.

In a microscopic study of cervical tissue from 669 cervices, which did not show any signs of carcinoma on gross examination and were treated for chronic inflammatory lesions, Smith discovered sixteen carcinomas of the cervix (2.39 per cent) by routine microscopic examination of the removed tissue.

Schmitz reports a 100 per cent five-year cure in the above mentioned fifteen cases of silent carcinoma which he discovered. This proves that only by early diagnosis and treatment the end results of cancer

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of the cervix can be improved and a good chance for recovery assured.

It should be kept in mind that there is very slow growth during the initial phase of carcinoma of the cervix. The initial phase may last for months or even several years (Nuttal, Todd, Healy, Behney).

Fig. 1. Case I. Glandular erosion of cervix, squamous cell metaplasia and small squamous cell carcinoma.

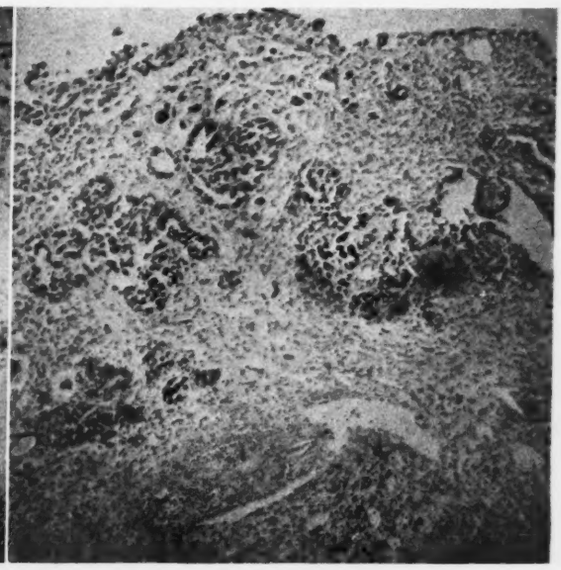

Fig. 2. Case IV. Small fragments of tissue with adenocarcinoma of the cervical canal.

Continuous irritation of tissue (Steiner, Smith) by chemical, bacterial and tissue extract agents, may be a predisposing factor in the development of carcinoma.

In the presence of a benign lesion, the beginning carcinoma can be easily overlooked. Most pathologists now agree that chronic inflammatory lesions, lacerations of the cervix at childbirth, and erosions are contributory factors in the development of malignancy of the cervix.

Eden Watts regards many borderline cases as suspicious but not definitely malignant. He believes that the erosion may become the seat of cancer. Beckman reports the development of a cervical carcinoma in an erosion treated by him for fifteen years.

The erosion accompanied by deep cervical laceration and thickening of the labia of the cervix is a strongly predisposing factor in the development of cancer. Watts, suggests, therefore, that any cervical laceration with thickening and everted erosion should be regarded as "precancerous" and should be treated by excision.

Many pathologists resent the expression "precancerous" as they believe that a lesion is either benign or malignant, but recent experience and studies seem to indicate that there can be a transient stage between the benign and the malignant.

Goodall and Power do not believe that scars of the cervix are a contributing cause of carcinoma of the cervix but the irritation of chronic endocervicitis and ectropion may have something to do with the beginning of carcinoma of the cervix. Meyer believes that erosion of the cervix has some influence in the development of carcinoma of the cervix and states that very frequently the carcinoma arises from the margin of an old erosion.

We note a rather general belief that there is a close relation between the benign and the early malignant lesion. Nevertheless, this fact is still being overlooked, as illustrated by the following characteristic case report by Fulkerson:

"Mrs. A. was admitted to the clinic on July 21, 1922. Aged thirty-seven years. Mar-

ried 10 years. No children. Three miscarriages, last six years before. No sickness. Complaints: pain on right side and in vagina; dyspareunia on and off for about two years, worse in last month. Slight discharge. Bowels regular. Uterus anteflexed, normal size. Diagnosis—cervicitis.

Fig. 3. Case II. Fairly advanced cell carcinoma located inside of the cervical canal.

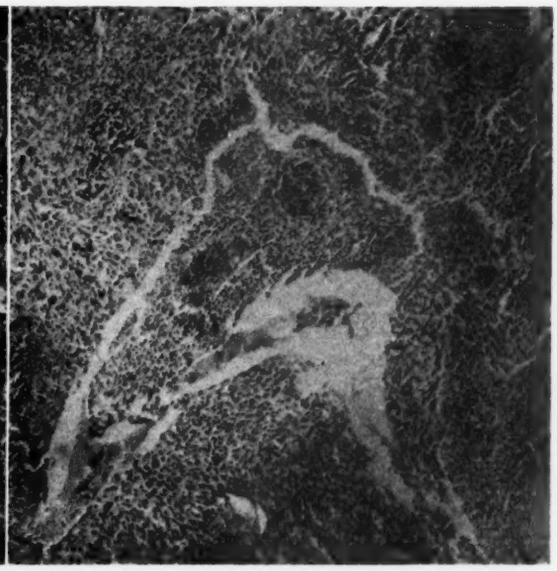

Fig. 4. Case III. Squamous cell carcinoma of cervix with marked secondary infection.

"The history taken and the first examination made by an experienced gynecologist and pathologist. She was treated by him and other members of his associate staff off and on for twenty-two months until May 1, 1924, when the cauterization was resorted. Considerable bleeding followed and healing did not take place. Two and a half months later the cervix was again cauterized. Improvement did not follow and the patient was referred to the hospital December 30, 1924. Examination showed erosion of the posterior cervical lip, destruction of cervical tissue up to vaginal junction, moderate erosion anteriorly and laterally about the external os with extension of carcinomatous tissue up into the cervical canal, involving by infiltration the entire cervix and with beginning parametrial involvement. Dilatation and curettage were done, followed by the insertion of 100 mg. of radium for twenty-four hours.

"The pathologic diagnosis was squamous cell carcinoma, only a small amount of normal endometrium being present.

"The complaint of pain in the vagina and increasing dyspareunia for two years, as well as the failure of the supposed cervicitis to improve under frequent treatments over a period of twenty-two months associated with the advanced involvement found at operation, is ample evidence that the disease was carcinoma from the beginning and that no change from cervicitis to malignancy occurred."

Undiscovered early malignancy of the cervix is very often mistaken for stump carcinoma. The incidence of "stump carcinoma" which, according to Ward ranges from 4.1 to 7.2 per cent, would be markedly decreased if routine biopsy preliminary to subtotal hysterectomies were done. It is not proposed to discuss in this paper the problem of total and subtotal hysterectomy, but frequently "stump carcinoma," which in many cases is nothing else but an early carcinoma of the cervix, is overlooked at the time of subtotal hysterectomy. Nuttall, Todd, Healy and Behney state that one to three years should elapse after the subtotal hysterectomy before the diagnosis of "stump carcinoma" can be made.

When performing a subtotal hysterectomy, we routinely do a radical conization of the cervix for two reasons: (1) To sterilize the cervix before doing a laparotomy, and (2) to obtain a biopsy and exclude the possibility of malignancy of the cervix.

Miller and Todd report 899 conizations done for different types of cervical disorders without any serious complication. They believe that when clearly indicated, conization is a splendid procedure.

It may seem that we have been rather radical in the use of conization but when one considers the percentage of carcinomas of the cervix, as yet relatively high, that are overlooked even by well trained gynecologists and surgeons, the procedure would seem to be justified, even in patients with less severe cervical disease in whom, according to some, simpler office methods might seem to be indicated. No seriously harmful complications ensued in any of our conization cases. Even in the superficial lesions treated by conization, the after-effects did not exceed those caused by simpler procedures.

Obtaining the right kind of specimen is a matter of importance. The pathologist can discover cancer only if the specimen he receives contains the lesion. Therefore, a poor biopsy may be worse than none. A negative biopsy report will bring a false sense of security while the carcinoma continues to grow undiscovered. Therefore, in suspicious cervices we do a radical conization with the belief that if the cervix should not be malignant, the removal of the diseased tissue may have some prophylactic value.

There are different ways of obtaining specimens for biopsy purposes: (1) excision, (2) scraping or excochleation, and (3) the use of the electrosurgical unit. We agree with Meyer, who states that the use of the electrosurgical unit for obtaining a specimen for biopsy purposes is the safest procedure as it is more apt to prevent the possibility of transplanting the carcinomatous cells into the blood stream than any other method.

Conization can be a completely bloodless procedure if the cutting and coagulation currents are well adjusted. We usually obtain a good specimen by using a rather high current so that fast cutting is achieved and only a very thin layer of the immediate surface of the tissue specimen can be destroyed by the heat.

We classify our conizations in three categories: (1) slight, (2) moderate, and (3) radical. If the lesions are more superficial, as in an erosion or for biopsy purposes, we use slight and moderate conization. In cases of edematous, chronic, cystic cervicitis or in cases in which amputation of the cervix, Sturmdorff's operation and trachelorrhaphy have been done, we usually do a radical conization.

The conization technic, as referred to in this paper, differs somewhat from the original one described by Hines and Cherry. After thorough inspection and examination of the cervix, the type of conization to be used is decided upon. The patient is put in the lithotomy position and after the vagina and cervix are cleansed, conization is carried out with the electrosurgical unit loop, the size of the latter varying in accordance with the size of the cervix and the type of conization. The cervix is grasped with a large Allis forcep and the conization done as shown in the drawings. We do not use sutures. If bleeding occurs during the procedure, fulguration of the bleeding points is done.

We find that the most suitable time for conization is immediately after the menstrual period. Coning out the cervix just before the menstrual period or between periods may cause an increase in the menstrual flow and also bleeding from the conized area which is being macerated by the menstrual flow.

Slight and moderate conizations can be done without anesthesia and the patient allowed to go home the same day. The radical conization, however, is always done under general anesthesia, preferably sodium pentothal and oxygen. The patient is hospitalized for about three days.

Before leaving the hospital, the patient is always instructed to avoid intercourse for the next four weeks, take daily sitz baths and not to be alarmed if moderate vaginal bleeding should occur.

On the fourth or fifth day after conization, the thin necrotic layer of tissue will slough from the conized area of the cervix; the granulation tissue underneath will have some tendency to bleed. In our series of cases, we had two patients who had to be hospitalized because of vaginal bleeding one to two weeks following conization. These patients did not follow the instructions given them when they left the hospital.

The slough has usually completely disappeared in from three to six weeks depending on the type of conization used; the cervix is smooth and has almost the appearance of a nulliparous cervix. Little if any scar tissue results from properly performed conizations.

Realizing the facts described and discussed in the first part of this paper, we have come to the conclusion that early diagnosis and early treatment of all cervical lesions are essential in the control of cancer of the cervix. There are numerous methods described for the treatment of cervical lesions. This in itself indicates that none of them is perfect. Most types of therapy used in the treatment of such lesions are based on the destruction of the diseased tissue by heat, cold, chemicals, etc. Cauterization, at present, is the most favored method of treatment in this group. The extent of the destruction of tissue by cautery is usually to a greater depth than we realize and it is difficult to predict with accuracy just how much tissue

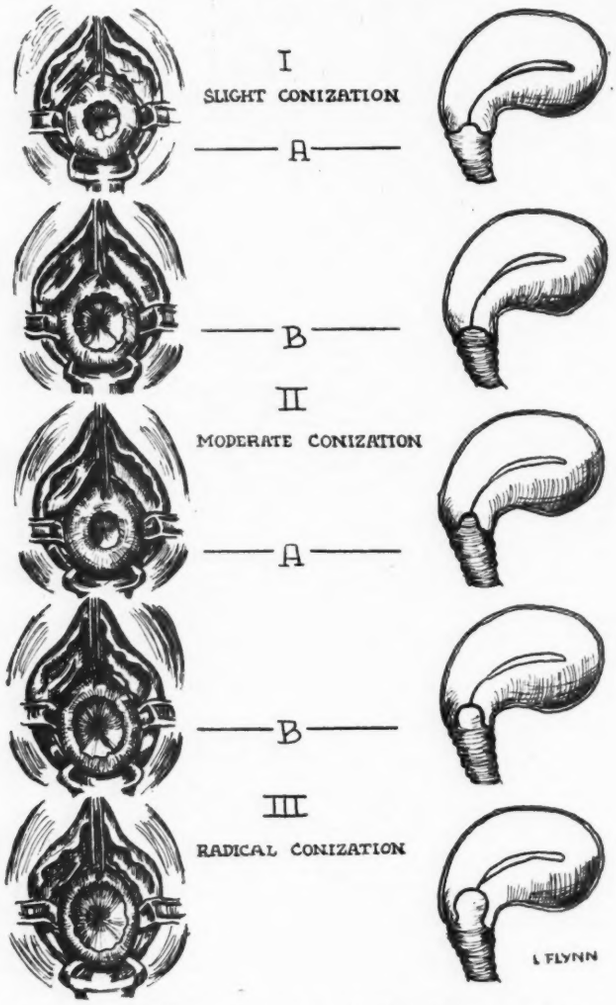

Fig. 5. Three different types of conization: slight, moderate and radical.

will be affected when this method is used. Bleeding following cauterization is not rare. Extensive scar formation and stenosis of the cervix may occasionally result. Only moderate stricture formation could be observed in two of our patients during check-ups following radical conization. Realizing that there are not enough cervical biopsies done, we believe we have found in "conization" the most practical combination of treatment and diagnosis.

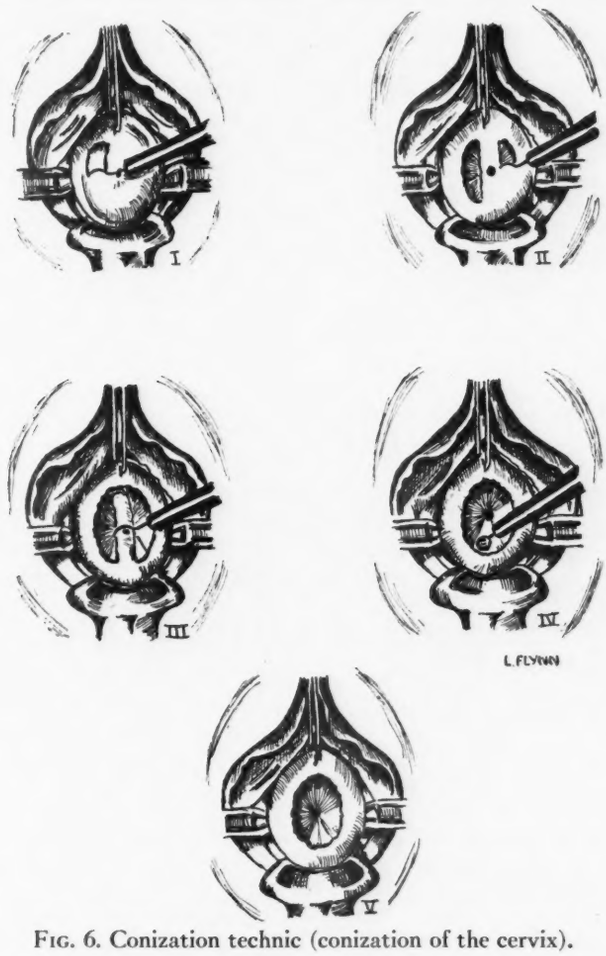

Fig. 6. Conization technic (conization of the cervix).

CASE REPORTS

Case 1. No. A-53349, E. W., a white female, age twenty-six years, was admitted to the Charleston General Hospital on July 26, 1943, complaining of lower abdominal pain which became more severe after menstrual periods and which was associated with fever and general malaise. There was a history of profuse vaginal discharge, also irregularity of menstrual periods. The patient had been admitted to the hospital two weeks previously at which time she had received conservative treatment (sulfathiazole, bed rest, etc,) for pelvic inflammatory disease.

Examination revealed marked tenderness in the left lower quadrant with a tender mass palpable in this area. On pelvic examination, both adnexal regions were very tender. A cystic mass was felt in the left fornix. The cervix was slightly eroded but mainly of normal consistency and bled only very slightly during the pelvic examination. There were no signs of induration. Temperature was 100°F., pulse 80 and respirations 20.

Laboratory examinations were essentially negative except for a leucocytosis of 19,600 leucocytes and 86 per cent neutrophils. Clinical diagnosis of chronic pelvic inflammatory disease with acute exacerbation and left tubo-ovarian abscess was made.

Operation was performed on July 31, 1943. Following a course of sulfathiazole, conization of the cervix and pelvic laparotomy were performed. Advanced chronic bilateral salpingitis with abscess formation in the left ovary was found together with hemorrhagic corpus albicans cyst on the right. The pathological report on the specimen obtained by routine conization of the cervix was glandular erosion of the cervix, squamous cell metaplasia, and small squamous cell carcinoma.

The postoperative course was complicated by a mild ileus. She was discharged August 10, 1943, markedly improved and returned on September 7, 1943, for radiation therapy of the cervix.

If cauterization instead of conization had been performed, this beginning carcinoma would have remained undiscovered and, if discovered later, would probably have been too far advanced for effective treatment.

Case II. No. A-38345, S. W., a white female, age twenty-one, was admitted to the Charleston General Hospital on June 14, 1942, complaining of right-sided abdominal pain of four years' duration. There was a history of one living child delivered about four years ago, and an appendectomy during the time of her pregnancy. Menstrual periods were irregular, profuse and prolonged and there was a rather excessive vaginal discharge between periods. As a rule, there was considerable discomfort associated with each period.

Examination revealed a well developed and well nourished white female in no acute distress. She was apparently in a state of psychoneurotic imbalance. There was an incisional scar over the right rectus region. Some tenderness was present in the right lower quadrant. Pelvic examination revealed much scarring in the region of the left side of the cervix and adjacent vaginal wall, apparently incidental to the delivery several years previously.

Laboratory findings were essentially negative except for pus (4 plus) in a catheterized specimen of urine.

Pelvic exploration and conization of the cervix were performed on June 18. The pathological report on the conization tissue was squamous cell carcinoma of the cervical canal. Radiation therapy was instituted.

Case III. No. A-46415; A-47265, B. S., a white female, age twenty-seven, was admitted to the Charleston General Hospital on April 12, 1943. There was a history of low abdominal pain and low backache with rather scanty occasional bleeding during the past two or three weeks. This patient had previously consulted her physician for similar complaints and a diagnosis of pelvic inflammatory disease had been made. A pelvic operation and cauterization of the cervix were done by this physician in September, 1942. Both tubes were found bound down with adhesions. The cornual portion of each tube was removed and the defect peritonized, the uterus suspended and routine appendectomy done.

Physical examination revealed a rather well developed individual in no acute distress with considerable tenderness through both lower quadrants. Pelvic examination revealed the cervix to be markedly eroded in an area about the size of a half dollar. This tissue was friable and bled easily on touch.

Biopsy of the cervix and conization were done on April 12, 1943. The pathological examination showed squamous cell carcinoma of the cervix with well marked secondary infection. Radiation therapy was instituted.

If conization instead of cauterization had been carried out at the time of the first operation, valuable time might have been saved and an early discovery of carcinoma might have been made.

Case IV. No. A-46415; A-45349, M. M., a white female, aged sixty-six years, was admitted to the Charleston General Hospital January 30, 1943, with a complaint of vaginal bleeding. The patient stated that since menopause at the age of fifty-two she had not noticed any abnormality until about six months ago, when she had a considerable amount of vaginal bleeding associated with some abdominal pain, and that since that time she had had recurrent attacks of vaginal bleeding at intervals. Otherwise her general health had been good.

Examination revealed a slight tenderness in the right lower quadrant of the abdomen extending to the midline. On pelvic examination a moderate amount of blood-tinged cervical discharge was noted. The cervix was sclerotic. No pelvic masses were palpable; the uterus was not enlarged. Laboratory examination was essentially negative. *X*-rays of the pelvis and lumbar spine were negative.

Diagnostic dilatation and curettage and also biopsy of the cervix by radical conization were done. A frozen section revealed necrotic fibroids and chronic cervicitis. Following this subtotal hysterectomy was done.

Unfortunately in this case, the frozen section did not reveal carcinoma; however, the final pathological report on the cervical tissue revealed adenocarcinoma of the cervix. Radiation therapy was instituted six weeks later.

Table 1

	No. of Cases
Patients treated by conization	311
Squamous cell metaplasia	11
Carcinoma of the cervix	18
Carcinoma of cervix disclosed by use of conization	4
Benign lesions of the cervix (multiple lesions occurring occasionally in one cervix) erosions, glandular cystic erosion, ectropion cervicitis (acute, chronic, cystic) endocervicitis, (acute, chronic) retention cysts, fibrosis, polyps, glandular proliferation	312

The 311 cases reported in this paper are based on conizations done at the Charleston General Hospital between July, 1942, and October, 1944.

The follow-up of our patients was rather difficult. Many of them lived a considerable distance from the hospital. Only a limited number of them could report for a personal check-up and only a little over 50 per cent of all patients who received questionnaires answered them, assisted by their local physician. Among 311 conizations, eighteen malignancies and eleven squamous cell metaplasias were found.

Some of the metaplasias were extensive and one case was highly suspicious for beginning malignancy. All patients with metaplasias were urged to return for repeated check-ups but comparatively few responded. Repeated biopsies on two patients with metaplasia who followed our advice and came in for check-ups did not reveal malignancy. The discovery of the four cervical carcinomas, 22 per cent of all the carcinomas reported in this paper, was made by conization. In none of the four reported cases did routine pelvic examination (palpation and inspection) reveal the malignancy.

CONCLUSIONS

1. The difficulty in diagnosing early carcinoma of the cervix has been pointed out, and the discovery of silent carcinoma by biopsy proved.

2. The relationship of benign and malignant lesions has been stressed and also the fact that certain benign lesions may be regarded as precancerous.

3. Any cervix with signs of the precancerous stage as pointed out previously, even if the lesion seems to be only superficial, should be conized. Routine radical conization should be done before subtotal hysterectomy. Radical conization, we believe, is the method of choice in all cervices with chronic cystic cervicitis and in cases in which amputation, Sturmdorff's operation and trachelorrhaphy are indicated.

4. Conization is a procedure combining treatment and diagnosis. By using high current, even very thin layers of tissue may be found as useful specimens for biopsy purposes.

5. Conization has been classified according to its use: (1) slight, (2) moderate, and (3) radical.

6. In our series of cases no more harmful after-effects have resulted from conization of the cervix, even in superficial lesions, than those following simpler office procedures.

7. After successful conization, relatively little scar tissue results and the cervix is usually restored to the appearance of a nulliparous one.

8. Early diagnosis of malignancy improves the chance of cure.

All tissue specimens were examined by Doctor Walter G. J. Putschar, Chief of the Pathological Department of the Charleston General Hospital. All microphotographs were obtained through the courtesy of Dr. H. M. Mican, Charleston, W. Va.

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MODIFIED TREATMENT FOR FRACTURE OF THE HEAD OF THE RADIUS

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RECENTLY note has been made of the frequent unsatisfactory results obtained in the treatment of fractures of the head of the radius, and immediate active motion has been suggested as a method to procure earlier and more complete recovery. In a small series of cases at this hospital, the value of early mobilization in this type of fracture has been confirmed. The purpose of this paper is to discuss briefly the rationale for this method of treatment, and to outline modifications which have been very helpful.

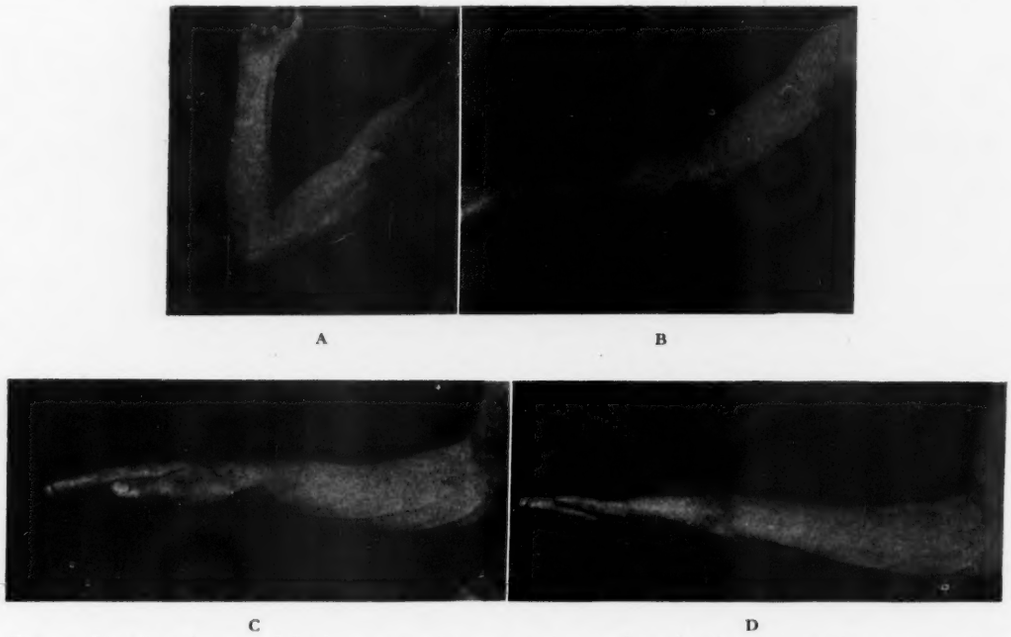
Fractures of the head of the radius may be divided into three classes: (1) linear fracture without displacement, (2) comminuted fracture with slight displacement, and (3) comminuted fracture with marked displacement. In class 3, operation is usually necessary and will not be included in this discussion. With the exceptions noted below, the treatment usually recommended for classes 1 and 2 is immobilization in a plaster cast or molded splint for periods of three to six weeks. This type of treatment is usually followed by a prolonged period of physiotherapy and other measures attempting to regain the lost range of motion in the elbow joint, with variable success.

Fontaine[1] reported one case of comminuted fracture of the head of the radius treated by repeated periarticular novocain injection and active motion with excellent result. Ferguson[2] treated five fractures of the head of the radius by Fontaine's method "with excellent functional results." Stimson[3] suggested aspiration of the joint followed by motion within pain limits after twenty-four hours. Neuwirth[4] reported a small series of fractures about the elbow treated by early mobilization, and included one case of fracture of the head of the radius. Mason and Shutkin[5] recorded a group of eighteen cases of fracture of the head or neck of the radius treated by immediate motion with 95 to 100 per cent recovery of function. Aspiration of the hemarthrosis and early active motion is also a procedure which has been widely used on the Fracture Service of the Presbyterian Hospital in New York.[6]

Mason and Shutkin[5] have stated the fundamental anatomic factors. The ulna and the radius articulating with the humerus form two condylar joints which do not have the same axis, nor do they move through the same arc. Perfect synchronization is necessary for full motion, and anatomic disturbance of the axis or arc of either joint will produce some degree of mechanical block. An anatomic reduction is essentially impossible, immobilization until bony union occurs will result in loss of synchronization and bony blocking, as evidenced by decrease in range of motion. By immediate active motion, however, the fractured head of the radius moves across the uninjured, fixed surface of the humerus, and the fragments thus attain the best functional position in relation to the various joint surfaces. It may be added that the orbicular ligament will prevent further displacement in this type of fracture.

The diagnosis of these fractures usually presents no difficulty, although occasionally special oblique roentgenograms are necessary to visualize the fracture line. The patient complains of increasing pain and decreasing motion, most often beginning one to three hours after injury. Examination showed marked limitation

of motion, particularly pronation and supination, bulging of the joint capsule, and tenderness over the head of the radius. Even at rest the pain due to the hemarthrosis is marked.



A B C D

FIG. 1. Showing degree of flexion, extension, pronation and supination twenty-four hours after joint aspiration and procaine injection. Motion was painless and not forced. On admission, twenty-eight hours after fracture, flexion was to 100 degrees, extension 120 degrees, and pronation and supination 40 per cent of normal.

After the diagnosis has been established the elbow is shaved and the skin prepared with ether, iodine and alcohol. In a triangle formed by the head of the radius, the lateral epicondyle and the tip of the olecranon there will be found a fluctuant swelling representing the distended joint capsule. A small wheal is raised in the center of this triangle, using 1 per cent procaine, and an 18 or 19 gauge needle introduced into the joint. From 15 to 30 cc. of blood may be obtained, with pressure being made on the anterior and posterior pouches of the joint. From 5 to 8 cc. of 1 per cent procaine is then injected into the joint. If the aspiration is performed soon after injury and before the bleeding has stopped, reaccumulation of blood may necessitate a second aspiration and injection.

FIG. 2. Roentgenogram of patient in Figure 1; linear fracture with slight separation; class A.

There will follow marked relief of the pain and an increase in the amount of motion without pain. The arm is placed in a sling. For the first seven days after injury, the patient is instructed to remove the arm from the sling four times daily, exercising the elbow within pain limits for about twenty minutes each time. The sling is removed after a week, and the patient allowed to begin simple tasks using the

arm, but always taking care to remain within pain limits.

No hot packs, diathermy, massage, or other physiotherapy is given for the following reasons: The early pain is eliminated largely by joint aspiration and procaine injection. Circulation about the elbow joint is adequate, and no stimulation for improved blood flow is necessary. More important, by placing the responsibility of increasing the motion directly upon the patient, no dependence upon the physiotherapist is developed by the patient and greater effort to regain the motion will be made by him. The patient is instructed and encouraged each morning at rounds, and thus far the response has been excellent.

The time of discharge from the hospital varies with the particular job to which the soldier is assigned, those performing light office work being released earlier than those doing full field duty. No heavy work is allowed until it is thought that firm union has occurred. Frequently, a short convalescent furlough is given.

Earlier, six patients were treated in a manner similar to that suggested by Mason and Shutkin, with excellent functional results in much shorter time than those treated by the conventional method. More recently, eight patients have been treated by the method outlined above. Six of the latter group had a fracture of the head of the radius with little or no displacement, and have been placed in class 1. Two had moderate displacement of the fragment, and have been placed in class 2. To determine the length of hospitalization would be of no value in this series. The assignment of two of the soldiers was such that they were allowed to return to duty immediately after treatment, reporting to the clinic frequently for observation. Others were given convalescent furloughs, thus permitting discharge earlier than would have been possible otherwise. A few patients remained in the hospital until it was believed that they could perform reasonably heavy work. In the average case about fourteen days' hospitalization is required, with return to light duty in four weeks and full duty in six weeks. The recovery of function has been complete in all cases except one patient (class 2) who lacks full extension by less than 5 degrees.

A B

Fig. 3. Roentgenogram of class B fracture, with displacement of the fragment.

An accurate determination of the time required for complete recovery is very difficult in these cases, in both military and civilian patients. Nevertheless, with joint aspiration, procaine injection and immediate active motion, the patient is rarely absent from duty more than three to five weeks and may not lose even one full day. This is in marked contrast to those treated by immobilization, when the soldier

may need seven to ten weeks' treatment before returning to duty.

SUMMARY

Fractures of the head of the radius which do not show marked displacement will recover more promptly and completely if treated by joint aspiration, procaine injection into the joint and immediate active motion. The aspiration of the hemarthrosis and the injection of procaine will produce relief of the severe pain which occurs soon after injury, and will permit earlier increase in the range of motion.

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THE commonest cause of delayed union in closed fractures is inadequate splinting. Fractures in certain locations as the neck of the femur and the wrist joint unite more slowly than the average. Most cases respond to further immobilization and frequent applications of heat.

From "Fractures and Dislocations for Practitioners" by Edwin O. Geckeler (The Williams & Wilkins Company).

THE RÔLE OF LYMPHOID HYPERPLASIA IN ACUTE APPENDICITIS*

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THE frequency with which abdominal pain has been noted in the course of infections of the upper respiratory tract, has led to many investigations in an effort to determine what relationship, if any, may obtain between the two.[5,6,17,25] The earlier studies of this association brought out the fact that many of these cases have an associated mesenteric lymphadenitis or hyperplasia of the lymphoid tissue of the intestines.[1,9,14] Other investigators have reported lymphoid hyperplasia and mesenteric lymphadenitis in the course of infections of the gastrointestinal tract, e.g., acute gastro-enteritis, typhoid fever, and tuberculous enteritis.[7,13,14,18,19,20]

It is accepted that lymphoid hyperplasia takes place in many subjects as a part of a generalized response of lymphoid tissue to the presence of infection; and that the lymphoid tissue of the appendix may share in this response is supported by the observations of Bowers,[4] Gray and Heifetz[10] and Held and Goldbloom.[11] Schroeder[22] and Sauer and Bailey,[21] reported the occurrence of appendicitis with tonsillitis, and Behrend[2] believes that "throat infections" are a contributing factor in the etiology of many cases of appendicitis. Bothe and Pote[3] reported the finding of an acutely inflamed appendix in an individual with an acute gastro-enteritis.

In support of the Aschoff theory of the origin of appendicitis Gray and Heifetz[10] expressed the belief that lymphoid hyperplasia in the appendix may cause stasis in the mucosal crypts due either to occlusion of the appendiceal lumen or of the crypts themselves. With stasis in the crypts, inflammation within them may soon follow, spreading in the form of acute suppurative or gangrenous appendicitis.

TABLE I
APPENDICITIS
Pathological Diagnosis and Mortality

Diagnosis	No.	Deaths	Mortality, Per Cent
Gangrene without perforation	16	0	0
Gangrene with perforation	17	3	17.5
Suppurative without perforation	75	1	1.3
Suppurative with perforation	17	0	0
Acute non-suppurative	129	0	0
Raised intraluminal pressure alone	41	0	0
Peri-appendicitis	7	0	0
Chronic fibrosis with obliteration of lumen	10	0	0
Enterobius infestation	2	0	0
Tuberculous	2	0	0
No pathological diagnosis	40	0	0
Totals	356	4	1.12

Wangensteen and Dennis[24] are of the opinion that appendicitis begins as a closed loop obstruction and list lymphoid hyperplasia as one of the factors which may be responsible for the obstruction.

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These views are also shared by McCallig.[16] Here the obstruction is intraluminal; however, Urech[23] has observed cases in which obstruction in the appendix was caused by compression from without by enlarged lymph nodes at the base of the appendix.

These recorded observations and impressions pointing to a close correlation between the occurrence of acute inflammation of the appendix and the presence of acute infectious processes elsewhere, prompted a critical evaluation of the records of all the patients operated upon over a three-year period in this clinic with a clinical diagnosis of acute appendicitis. This review revealed 356 patients operated upon from July 1, 1940, to June 30, 1943, with a total mortality rate of 1.12 per cent. The pathologic diagnosis and mortality rates are listed in Table I.

There were fifty-seven cases (16.01 per cent) found in which lymphoid hyperplasia was listed prominently among the pathological findings. The clinical and pathological findings in these cases are listed in Table II. That infection is a prominent factor in these cases is shown by the incidence of forty-eight cases (84.2 per cent) or 13.3 per cent of the total series. The distribution of the infections is noted in Table III.

It is significant to note that forty-four cases (78.5 per cent) of the fifty-seven had an associated finding of raised intraluminal pressure. In the total series there were observed one hundred cases (27.7 per cent) in which raised intraluminal pressure was noted on pathological examination. They were distributed as noted in Table IV.

In many of those cases in which suppuration or gangrene had caused distruction of the walls no definite diagnosis of lymphoid hyperplasia or increased intraluminal pressure could be made.

In this series the cases in which lymphoid hyperplasia was so prominently a feature were characterized by a history of an upper respiratory infection or gastro-intestinal upset for a few days to a week or ten days and gradually or suddenly develops colicky abdominal pains. In many cases the preceding infection may have only a brief interval between its onset and the onset of abdominal symptoms. The abdominal pains may begin and end in the right lower quadrant or they may be generalized at first and later become

TABLE II
CLINICAL FINDINGS IN THE CASES OF APPENDICITIS SHOWING LYMPHOID HYPERPLASIA

Findings	No.	Percentage	Percentage in Total Series
Associated or concomittant infection	48	84.2	13.3
Average days of incubation	4		
Average age	18.5		
Generalized pain initially	25	43.8	6.83
Right lower quadrant pains initially	32	55.2	8.98
History of recurrent attacks	31	54.4	8.7
Incidence of colicky pains	32	55.2	8.98
Nausea	47	82.5	13.2
Vomiting	40	70.2	10.94
Soft abdomen	45	78.9	12.65
Flat abdomen	47	82.5	13.2
Splinting (involuntary)	12	21.05	3.37
Average temperature	99[1]		
White blood count without complications	9,500		
White blood count with complications	12,175		
Gangrene	2	3.5	.56
Gangrene with perforation	2	3.5	.56
Suppurative	9	15.8	2.46
Suppurative with perforation	1	1.75	.28
Acute non-suppurative	23	4.03	6.46
Raised intraluminal pressure	15	26.3	4.21
Lymphoid hyperplasia alone	4	7.03	1.12

TABLE III
TYPE OF ASSOCIATED INFECTIONS IN CASES OF APPENDICITIS WITH LYMPHOID HYPERPLASIA

Type of infection	No.	Percentage	Percentage in Total Series
Upper respiratory	37	64.9	10.3
Gastro-enteritis	6	10.5	1.69
Other general infections	5	8.7	1.4
Total	48	84.2	13.3

localized in the right lower quadrant, findings which are common in appendicitis in general. The attacks are usually recurrent and the increased frequency or increased severity of the abdominal symptoms forces the patient to seek relief. Nausea and vomiting are usually present and the occurrence of anorexia is found in every case in which the inflammatory process in the appendix is severe.

TABLE IV
CAUSES OF RAISED INTRALUMINAL PRESSURE

Group	No.	Percentage in Total Series
Lymphoid hyperplasia	44	12.38
Adhesions	23	6.45
Fecaliths	11	3.08
No discoverable cause	22	6.18
Total	100	27.1

The abdominal findings enhance the approach toward a correct diagnosis. In early cases in which the main pathologic process is lymphoid tissue reaction with or without closed loop obstruction but without inflammation, the abdomen is usually flat and soft. However, in the apprehensive or anxious patient voluntary splinting may be noted. Only in the advanced case do you find involuntary splinting. There is tenderness over the base of the appendix; rebound tenderness and Rovsing's sign may be present. If suppuration, gangrene or perforation have occurred the other well known signs of peritonitis will be present. The rectal examination may reveal definite information, depending upon the stage of the process. If suppuration is not present, there may be no rectal tenderness and if there is tenderness it is usually slight. However, if suppuration is present, definite tenderness is noted upon tugging on the peritoneum, or and if perforation has occurred a mass may be noted.

The temperature is usually normal or slightly elevated, except in those cases in which the primary infection accompanies the abdominal symptoms. In these the temperature depends in all probability upon the extent of the primary infection. This fact may lead to confusion unless the entire clinical picture is appraised.

The white blood count is usually below 10,000, but again when the primary infection is present and inflammation has been added to the appendix, the white blood count is influenced by this and is above 10,000 in the majority of cases.

In this series, many of these patients when first seen were considered as cases of acute mesenteric lymphadenitis or subsiding appendicitis, yet they were operated upon in order not to incur the risk of overlooking an irreversibly inflamed appendix.[3,15,23] It is the conviction in this clinic that it is to invite disaster to discharge a patient with a diagnosis of acute mesenteric lymphadenitis without a period of observation. We agree that it is better to remove, through a McBurney's incision, a normal appendix[20,22] or one just showing increased intraluminal pressure with lymphoid hyperplasia than to send the patient home to develop a closed loop, suppuration, gangrene and perforation. These opinions stem in part from personal observations, for some of our cases, believed to have had merely mesenteric lymphadenitis, were observed and they developed under observation a typical picture of acute appendicitis, about which there was no doubt; and at operation an acutely inflamed appendix with increased intraluminal pressure and lymphoid hyperplasia were found.

CASE REPORTS

CASE 1. P. C., aged eleven years, female, was admitted complaining for three days of generalized colicky abdominal pains which later localized in the right lower quadrant. The attack was accompanied by a sore throat and was associated with nausea, vomiting and anorexia. Previous attacks were admitted, each preceded or accompanied by sore throats.

Physical examination revealed the following significant findings: a temperature of 100°F.; enlarged and injected tonsils; a hyperemic pharynx; enlarged cervical lymph nodes; a flat and soft abdomen with tenderness of deep

palpation over McBurney's point; rebound tenderness referred to the right lower quadrant and a positive Rovsing's sign was present; and mild rectal tenderness was present on the right.

The accessory clinical findings revealed the urine to be entirely normal. The white blood count was 10,150, with 78 per cent neutrophils and 22 per cent lymphocytes. The other laboratory data had no bearing on the complaint.

The patient was observed for twenty-four hours. During this time the tenderness persisted, and an appendectomy was advised. The pathologist (R. S. J.) reported a subsiding diffuse suppurative and ulcerative appendicitis with lymphoid hyperplasia and increased intraluminal pressure.

Case II. C. E., aged twelve years, male, was admitted complaining of right lower quadrant abdominal pains of one week's duration. The pains were colicky in character at the beginning, but later became dull. Nausea, vomiting and anorexia were present during the last three days of his illness, and he admitted having a "cold" for two weeks.

Physical examination revealed a dehydrated, well nourished individual with a temperature of 101°F., a pulse of 130, and a respiratory rate of 26. There was a foul odor to the breath. The left tonsil was hyperemic and the right tonsil was hypertrophied. There was a purulent exudate present in the pharynx. The abdomen was soft and flat with tenderness about 2.5 cm. medial to and below McBurney's point. Rovsing's sign was positive and rebound tenderness was generalized, but more marked in the right lower quadrant. There was moderate rectal tenderness on the right and slight tenderness on the left. The inguinal and cervical nodes were enlarged but not tender.

The white blood count on admission was 13,450 with 81 per cent neutrophils. Twenty-four hours later the white blood count was 26,000 with 93 per cent neutrophils. The urine was negative.

The patient was observed for twenty-four hours. During this time an attempt was made to restore his fluid balance by oral and parenteral routes. The symptoms progressed suggesting that the patient had developed an acute appendicitis. A gangrenous appendix with lymphoid hyperplasia was removed.

Case III. E. H., aged ten years, male, was admitted complaining of dull para-umbilical pains of twenty-four hours' duration associated with nausea, vomiting and anorexia. There was no disturbance in bowel habits. The onset of abdominal pains was preceded for about a week by a severe "cold" and sorethroat.

Physical examination revealed a well developed male child in no apparent distress. His tonsils were enlarged and hyperemic. The cervical and axillary lymph nodes were enlarged, freely movable, and non-tender. There were scattered râles over the bases of the lungs, but no evidence of consolidation was present. The abdomen was flat and soft with generalized mild tenderness, and exquisite tenderness in the region of McBurney's point. Rebound tenderness was generalized and Rovsing's sign was positive. There was a positive psoas test on the right and a suggestive one on the left. No masses were palpated. There was no rectal tenderness or mass.

The temperature on admission was 100°F., and the white blood count was 14,300. Two days later the white blood count was 13,950 with a slight increase in neutrophils. The other laboratory findings bore no relation to the complaint.

During the first twenty-four hours after admission the patient was given sulfathiazole and oral and parenteral fluids. He was examined at frequent intervals. On the morning of the second day after admission the pains became colicky in character and involuntary splinting of the right side of the abdomen was noted. It was believed that the patient had developed an acute appendicitis. Through a McBurney's incision the appendix was removed. It was reported by the pathologist (R. S. J.) as an acute suppurative appendicitis with lymphoid hyperplasia and evidence of markedly increased intraluminal pressure.

Case IV. E. B., aged forty-nine years, female, was admitted to the medical service complaining of generalized, crampy, abdominal pains and diarrhea for six days. The gastrointestinal upset followed a meal of fresh cold pork. Nausea was severe, but there was no vomiting. Anorexia was present. Three days prior to admission the stools became black in color. Previous gastrointestinal upsets were denied.

Physical examination revealed an acutely ill patient was a temperature of 103°F., with rapid respirations and a tendency toward restriction of motion in the lower chest. The lung fields were clear. The abdomen was

markedly distended and very tense with a suggestion of involuntary splinting. Tenderness was generalized, but more marked in the left upper quadrant. No masses were palpated. The abdomen was tympanitic throughout and there was striking silence on auscultation. The rectal examination showed exquisite tenderness high in the abdomen and on manipulation of the uterus. Vaginal examination revealed no additional information.

The white blood count was 14,750 with 88 per cent neutrophils. Twelve hours later the white blood count was 20,125 with 93 per cent neutrophils, and the hematocrit was 38 per cent. The urine showed a specific gravity of 1026, plus 2 albumen, and a plus 3 Benzidene test. A scout film of the abdomen failed to reveal any evidence of a ruptured viscus.

A surgical consultation twenty-six hours after admission revealed findings suggesting an acute condition of the abdomen with the patient in impending shock. The differential diagnosis included: (1) ruptured peptic ulcer because of the site of onset, gradual shifting of pain down right gutter and reported blood in the stool; (2) possibility of a severe gastroenteritis with secondary involvement of the appendix and generalized peritonitis with a paralytic ileus. When conservative measures had failed to relieve the distention, shock and respiratory embarrassment, an exploratory laparotomy was done with the hope of bringing about some decompression and controlling the source of contamination. A gangrenous ruptured appendix and generalized peritonitis was found. The patient expired forty-five minutes after anesthesia was begun, exactly thirty-one hours after admission.

The postmortem examination revealed a generalized fibrinopurulent peritonitis; marked generalized mesenteric lymphadenitis; submucosal petechial hemorrhages in the stomach and small intestines; cloudy swelling in the liver, and bronchopneumonia.

COMMENTS

Cases I, II, and III were admitted with a diagnosis of acute mesenteric lymphadenitis associated with an upper respiratory infection and were observed for twenty-four hours or longer. In Case I, appendicitis was probably present before the patient was admitted to the hospital and was subsiding when she was first seen. However, because of the persistent tenderness an appendectomy was performed. This patient presented a history of previous attacks of abdominal pains associated with sore throats, findings which are not unusual in cases of mesenteric lymphadenitis.[1] The presence of colicky pains suggested an obstruction. In addition to the factors which are known to play a part in predisposing to serious infection of the appendix, once the organ has been obstructed it is quite possible that another mechanism plays a part in a case such as the one under consideration. It is quite likely that in such a case the respiratory infection is mild in character and subsides early, allowing the process in the appendix to subside before complications set in.

Cases II and III progressed while under observation. There was an increased neutrophilia, the symptoms and findings changed from mild to severe, and the appendix in both cases showed an advanced pathological state. In Case II the abdominal pains were colicky in character at the onset suggesting appendiceal obstruction from the onset.

In Case III the initial abdominal pains, although confined to the right lower quadrant, were dull in character and later became colicky. Shortly after the appearance of the colicky pains, involuntary abdominal splinting was noted, suggesting involvement of the peritoneum. It was believed that an acute suppurative appendicitis was the most likely cause. This was confirmed by surgery. Here it is believed that the initial abdominal symptoms and findings were due to an acute mesenteric lymphadenitis. The dull pains were due to edema of the nodes, and the localization of the pain in the right lower quadrant was due to the fact that the mesenteric nodes are more abundant in the ileocecal region.[12] As the primary infection progressed an increased lymphoid response occurred with an ultimate involvement of the lymphoid tissue of the appendix, resulting in an obstruction which progressed to suppuration before the ap-

pendix was removed. The occurrence of the colicky pains probably coincided with the involvement of the lymphoid tissue in the appendix.

Case IV in the early stages probably represented a simple uncomplicated acute gastro-enteritis, but as the infection continued the regional lymph nodes became involved with subsequent involvement of the lymphoid tissues throughout the abdomen including the appendix. The exact time of the appendiceal involvement could not be determined because the patient was too toxic to give a clear and detailed history. As the primary infection continued, the obstruction in the appendix progressed with gangrene and perforation being added. Probably if the picture had not been complicated by an acute gastro-enteritis, the time the appendiceal symptoms developed might have been noted and a correct diagnosis could have been made, resulting in a more favorable outcome.

SUMMARY

1. In a series of 356 patients operated upon with a clinical diagnosis of acute appendicitis fifty-seven or 16.1 per cent showed on microscopic examination lymphoid hyperplasia as a prominent pathological finding.

2. In forty-eight or 84.2 per cent of these fifty-seven cases showing lymphoid hyperplasia there was a history of concomittant or preceding infectious process.

3. In one hundred cases which showed evidence of raised intraluminal pressure, lymphoid hyperplasia in the appendix appeared to be an etiological factor in forty-four cases.

4. The clinical picture in cases of appendicitis caused by lymphoid hyperplasia is discussed.

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MUSCLE HERNIAS OF THE LEG*

REVIEW OF LITERATURE AND REPORT OF TWELVE CASES

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MUSCLE hernia, or protrusion of muscle tissue through a defect in the fascia which confines it, has received relatively scant consideration in the literature. The condition, however, is not rare, and a more careful consideration of the subject is warranted, particularly in view of its frequent recognition in military personnel.

LITERATURE

Ihde,[1] in 1929, reported twelve cases of muscle hernia of the leg and one of the thigh, all in military personnel. He reviewed the literature carefully and stated that the earliest description was by Richet[2] in 1855, and that by 1881 thirty-five cases of all types of muscle hernia were reported, five of them in the leg. From then to 1901 nine additional cases were reported, making a total of fourteen cases of muscle hernias of the leg.

Ihde quoted the investigations of Féré[3] in 1900, who found thirty-one cases of hernia of the leg in 204 institutional epileptic patients, and of Pichon[4] who in 1906 reported thirty-nine muscle hernias and aponeurotic ruptures in 217 Alpine soldiers. Ihde, however, questioned the diagnosis in some of the latter series because only two of them were of a permanent nature. He states that Hesse[5] in 1921 first repaired these hernias with fascia transplants.

Ihde divided the muscle hernias into traumatic and constitutional or distention hernias, the former arising as a result of direct or indirect violence and the latter arising slowly, with very little discomfort, and which he held to be a part of the phenomena somatically characteristic of a general mesodermal insufficiency; but specific evidence of such insufficiency to support this theory was not found in his case reports.

Following this report, little was written about the subject for a number of years. Among others, Haldeman and Soto-Hall,[6] in 1935, and Hartzell,[7] in 1936, each reported a hernia of the tibialis anticus muscle from direct injury successfully repaired by sutures from the fascia lata. Conwell and Alldredge[8] reported two cases, one a hernia through the fascia lata which they believed to be strangulated but not proven surgically, and one a hernia of the gastrocnemius muscle from a gunshot wound of the leg which was also not treated surgically because of absence of symptoms.

Since the present mobilization of the army, Schaefer[9] reported thirteen cases, Kitchin and Richmond[10] three cases, and McMaster[11] thirty-eight hernias in twenty-one patients, all in 1943, and the present report deals with twelve additional patients with twenty-four hernias. All of these reports have been limited to military personnel.

In all, Ihde mentioned ninety-three cases of muscle hernias of the leg reported in the literature and added thirteen of his own. We have been able to find reports of forty-five additional patients which, with ours, makes a total of 163 cases of muscle hernias of the leg. This does not represent a complete review of the literature, however.

CASE REPORTS

The observations in twelve cases of muscle hernias of the leg form the basis of this discussion; three were due to direct

* The drawings were made by Pfc. Kermit R. Finley.

injury and nine were of the idiopathic or indirect type.

Case 1. A nineteen year old soldier cut the lateral aspect of the middle third of the right leg with an axe in 1940. The wound was closed with four sutures. One week after removal of the sutures, separation of the wound occurred with purulent discharge; healing resulted two weeks later. He was symptom free until his basic training in the army in February, 1943, when a small swelling appeared at the site of the old injury. The swelling progressively enlarged for two to three weeks and then remained stationary. It increased in size when standing on the toes and became smaller when the leg was elevated. A dull pain was experienced in this region after calisthenics, walking or driving a car.

Examination revealed a wide, slightly depressed, adherent scar just below the midportion of the anterolateral aspect of the right leg. On dorsiflexion of the foot, and on standing, a mass about 2 or 3 cm. in diameter appeared at this site. It was uniformly soft, semi-fluctuant and partly reduceable on pressure and on plantar flexion of the foot, revealing a sharp-edged, oval defect in the anterior tibial fascia. Neither thrill nor bruit were present.

At operation under local anesthesia, the scar was excised and dissected free from the underlying tibialis anticus muscle which protruded through an oval defect in its fascia, approximately 3.5 by 5 cm. (Fig. 1.) The muscle tissue appeared normal, but was intimately attached to the overlying scar tissue. The edges of the fascial defect were smooth, firm and tense and the fascia was loosely adherent to the underlying muscle. The muscle was separated from the fascia and reduced. An attempt was made to approximate the edges of the defect but even when its attachments to the tibial periostium were cut, the fascia constituting the inner border could not be mobilized outward due to its rigidity and tenseness.

A patch of fascia lata a little larger than the defect was removed, stripped clean and sutured snugly over the defect with multiple interrupted sutures of No. 70 white cotton thread. (Fig. 2.) The skin and subcutaneous tissues were closed with similar sutures and a dressing and elastic bandage applied snugly from the toes to the knee.

The foot was flexed and extended passively once daily to prevent adhesions but motion was otherwise prohibited. The wound healed primarily, the patient was permitted up on crutches on the fourteenth day, and allowed to walk after three weeks. There was free motion of the foot and ankle and absence of all deformity and discomfort.

Case 11. A twenty-seven year old soldier fractured the middle third of the left tibia in April, 1936. Two months later, because of nonunion, an open reduction was performed. After a prolonged convalescence of eighteen months, recovery was complete except for a small elevation lateral to the site of fracture on the side opposite the surgical repair. The mass was tender and pain radiated into the ankle. The resultant disability led him to seek a sedentary type of employment. During his basic training in 1942, the mass enlarged and pain and tenderness became severe enough to interfere seriously with drill and marching.

Examination revealed a vertical scar on the anteromesial aspect of the middle third of the left leg. On the anterolateral surface over the belly of the tibialis anticus muscle, there was a soft, tender, semi-fluctuant mass measuring 8 by 5 cm. Tenderness was present over the mass and along the medial aspect of the tibia.

The mass increased markedly in size with plantar flexion and when the patient stood on his toes. It decreased markedly in size with dorsiflexion of the foot or when the leg was elevated. It could be partly reduced on pressure and the edges of a fascial defect could be indistinctly outlined. No thrill or bruit were elicited. The overlying skin and the vessels of the leg appeared normal. Muscle hernia was considered in the diagnosis, as well as lipoma and angioma, and surgery advised.

At operation, under local anesthesia, a curved incision was made along the outer border of the mass and the overlying skin dissected free, revealing a mass of muscle tissue protruding through an irregular defect in the tibialis anticus fascia. (Fig. 3.) The defect measured 8 cm. in its vertical and 5 cm. in its horizontal dimension. The edges were adherent to the underlying as well as to the protruding portion of the muscle, preventing its complete reduction.

The edges of the fascia were dissected free and the adhesions separated from the under-

lying muscle for a distance of 5 or 6 cm. Closure of the defect with a single fascia lata transplant was not feasible because of its size.

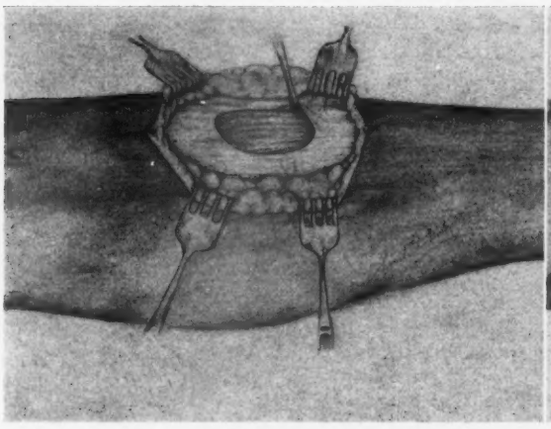

Fig. 1. Case 1. Muscle hernia through defect in tibialis anterior fascia.

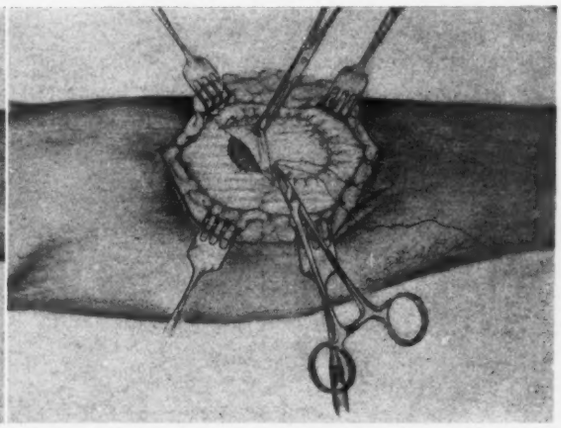

Fig. 2. Case 1. Repair of defect of tibialis anticus fascia with fascia lata transplant.

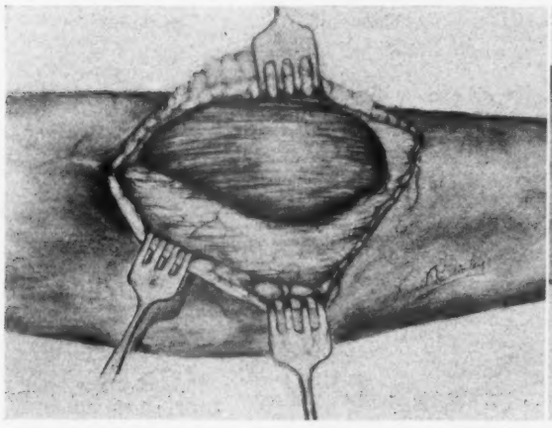

Fig. 3. Case 11. Muscle hernia through tibialis anticus fascia.

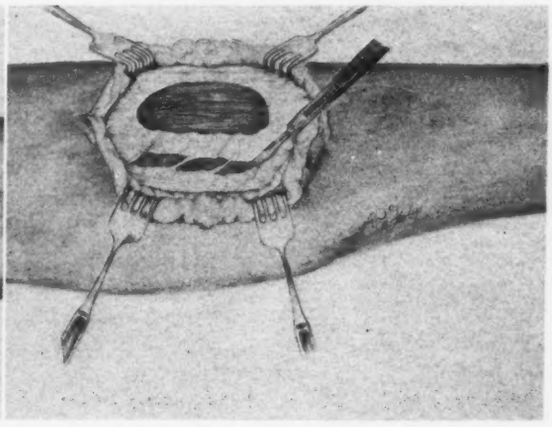

Fig. 4. Case 11. Narrowing of defect by parallel lateral incision and sliding strip of fascia medially.

An attempt was made to narrow it by separating the fascia medially from its attachment to the tibia, but mobilization on this side was impossible due to its rigidity. Laterally, a strip of fascia was shifted inward for a distance of about 1.5 cm. when a lateral parallel incision was made, thus narrowing the defect correspondingly. (Fig. 4.) The two resultant defects were repaired by means of narrow strips of fascia lata woven back and forth between the two borders of each defect. The fascial strips were anchored to each other and at the points of their passage through the borders of the defect with interrupted sutures of No. 70 white cotton thread. (Fig. 5.) Throughout the operation, the fascia and all exposed surfaces were kept covered with warm saline packs. The skin and subcutaneous tissues were closed throughout with interrupted sutures of No. 70 white cotton thread. A large, soft gauze pad, a pressure bandage and a thin plaster of paris cast were applied. Because of prolonged wound exposure necessitated by the operation, a heat cradle was placed over the leg and sulfathiazole was given orally for the first three days.

Postoperatively, there was no discomfort in the wound but there was moderate swelling of the foot and ankle which subsided when the cast was bivalved. There was temperature elevation within twelve hours to 101°F., associated with headache, generalized aching, malaise and nausea. These symptoms promptly subsided on withdrawal of the sulfathiazole and convalescence thereafter was uneventful. The sutures were removed on the tenth day; the cast was removed at the end of two weeks. At the end of the third week, walking was

permitted. There was no evidence of recurrent swelling or symptoms.

Case III. A twenty-three year old soldier

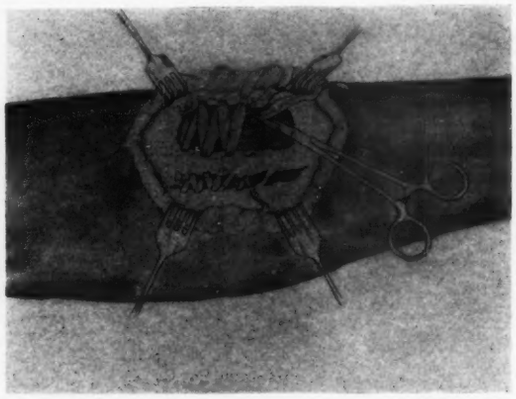

Fig. 5. Case II. Repair of defect by strips of fascia lata.

gave a history of a fracture of the right leg in 1937. Soon afterward a swelling appeared at the site of the fracture. There was moderate aching after excessive walking.

On examination, there was a semi-fluctuant round mass on the anterolateral aspect of the mid-portion of the right leg, at the site of the old fracture. The mass disappeared with the foot in dorsiflexion and enlarged with plantar flexion. It disappeared when the leg was elevated and was reducible on pressure, leaving a definitely outlined, palpable defect in the anterior tibial fascia about 1.5 cm. in diameter. At aspiration, nothing was recovered.

A diagnosis was made of herniation of the tibialis anticus muscle through a defect in its fascia. Because of the mildness of the symptoms, surgery was not advised.

Case IV. A soldier, aged twenty-nine years, presented himself at a routine physical examination without complaints. Three circumscribed swellings were present on the right leg: one had appeared eight years previously while engaging in football and track, two had been present for three years. The onset had been gradual and without apparent cause, the appearance of one had been immediately preceded by a spontaneous subcutaneous hemorrhage. He had received no direct injuries to the legs. There was no tenderness, pain or other associated symptom.

On examination, an oval elevation was present about 3 cm. lateral to the mid-portion of the right tibia; it became prominent with standing on the toes and plantar flexion of the foot; it disappeared on dorsiflexion and on elevation of the leg, and was reducible by pressure revealing an oval defect in the fascia. Two circumscribed elevations were present on the lateral aspect of the right ankle, one above the other, about 4 cm. above the shoe tops. They enlarged on standing on the heel, and became smaller when standing on the toes and were little effected by flexion and extension of the foot. Reduction was accomplished without tenderness by pressure, revealing oval defects in the fascia. Treatment was not advised because of absence of symptoms.

Case V. A thirty-six year old soldier complained during a routine physical examination of aching in the right leg, on the outer aspect and into the arch of the foot, aggravated after walking. Eight or ten years previously he had been quite active playing often eight sets of tennis daily. Five and three years previously he had been in automobile accidents but had suffered no direct injury to the legs in either accident. For about two years, three swellings had been present on the right leg; they had enlarged gradually and were not tender. In civilian life he had been a truck driver; during thirteen months' service in the army, he had not undergone any strenuous exercise.

On examination, two symmetrically placed oval swellings were present on the lateral aspect of each leg, about 4 centimeters above the malleoli, one above the other. A fifth was situated on the anterolateral aspect of the mid-portion of the right leg and a sixth on the medial aspect of the middle of the left leg. (Fig. 6.) They measured .8 to 1 cm. in diameter and were oval to round in shape. On plantar flexion and when standing on the toes the swellings became more prominent; on dorsiflexion and when the legs were elevated, they disappeared. Reduction was accomplished in each instance by pressure revealing sharp-edged round or oval fascial defects. Multiple, spontaneous muscle hernias were diagnosed but because of the mildness of symptoms, surgery was not advised.

Case VI. A medical officer, aged twenty-nine years, demonstrated a soft, semi-fluctuant tumor about 1 cm. in diameter situated about 2 cm. lateral to the mid-portion of the right tibia, present for about twelve years. It was first noted during attendance at college, while he was engaging in wrestling. It had been entirely asymptomatic and was never asso-

ciated with tenderness or ecchymosis. It had enlarged slightly. The swelling became prominent when he stood on his toes and on plantar

Fig. 6. Case iv. Multiple spontaneous muscle hernias prominent when standing on toes.

flexion of the foot. It disappeared on dorsiflexion of the foot, and when standing on the heels or with the leg elevated; it was reducible by pressure, revealing a circumscribed defect in the tibialis anticus fascia. Because of complete absence of symptoms, surgery was not advised.

Case vii. A soldier, aged thirty-one years, had found two swellings on the left leg five years previous to examination while he was doing unusually heavy work loading box cars. Symptoms were absent except for unusual fatigability at the onset.

On examination there were three circumscribed swellings each about 1 cm. above the other on the anterolateral aspect of the midportion of the left leg about 3.5 cm. lateral to the crest of the tibia. They increased in size with plantar flexion or when standing on the toes, and disappeared when the leg was placed in the horizontal position or when the foot was dorsiflexed. With pressure, they were easily reduced and revealed a palpable defect in the fascia. Because of absence of symptoms, surgery was not considered.

Case viii. A soldier, aged thirty-eight years, had noticed two or three inconstant swellings on the left leg three years previously.

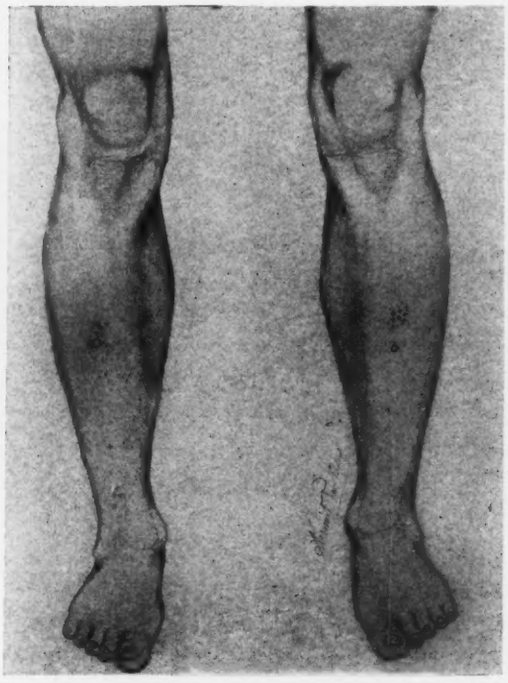

Fig. 7. Localization of muscle hernia in twelve patients observed by the authors: o, traumatic hernia; +, spontaneous or idiopathic type.

For about eight months they had been present constantly, slight soreness and aching appeared after walking or exercise. As a civilian he was a barber, but frequently engaged in hunting as a pastime.

On examination, two circumscribed swellings were present; one on the mid-left leg about 2 cm. lateral to the tibial border, and one on the lateral aspect of the leg just above the external malleolus. They increased in size when standing on the toes or with the foot in plantar flexion and disappeared with the leg in the horizontal position or dorsiflexion. With pressure, the swellings were easily reduced and fascial defects were palpable each about .6 cm. in diameter. Muscle hernias were diagnosed but surgery was not considered because of the minimal symptoms.

Case ix. A soldier, aged twenty-six years, had discovered a swelling in the left leg five years previously while he was doing strenuous construction work. At first it was inconstant but since induction into the army, sixteen months previously, it had been present constantly. Moderate tenderness and pain were present, especially after running or fast walking.

On examination, a circumscribed swelling about .5 cm. in diameter was present along the lateral border of the left tibia at about its midpoint. It increased in size when standing on the toes and disappeared when standing on the heels or when the leg was in the horizontal position. It did not enlarge with either dorsi- or plantar flexion of the foot, probably because of its situation near the tibial border and the attachment of the muscle. Reduction was easily accomplished by pressure, revealing a defect in the fascia.

Muscle hernia was diagnosed, but surgery was not advised because of minimal symptoms.

Case x. A soldier, aged twenty-one years, was unaware of any swellings in the legs and had had no symptoms except cramping in the calves or feet after walking or exercise. He had never done any strenuous work prior to basic training at the time of induction.

On examination there were bilateral circumscribed swellings, on the right about one inch above and on the left about the same distance below the mid-leg, each about 2 cm. lateral to the tibial border. They increased in size with standing on the toes or plantar flexion of the foot; they disappeared when the leg was horizontal or dorsiflexed and with pressure, when defects could be palpated in the fascia. Bilateral muscle hernias were diagnosed but surgery was not advised because of absence of symptoms.

Case xi. A soldier, aged twenty-two years, had a circumscribed swelling on the left leg for two years or longer without symptoms except increased fatigability of the left leg during basic training. He had participated in baseball and track. On examination there was a localized swelling about 1.5 cm. in diameter on the middle third of the left leg about 2 cm. lateral to the tibial border. It increased in size on standing on the toes and disappeared on standing on the heels. Surgery was not advised.

Case xii. A soldier, aged twenty-nine years, had numerous and varied complaints typical of psychoneurosis. He had not been aware of any localized elevations in his legs.

On examination there were two localized swellings on the anterolateral aspect of the right leg, one about 1 cm. in diameter at the middle of the leg, and the other at the junction of the middle and lower third of the leg, about 2 cm. in diameter. They became prominent when he stood on his toes, and disappeared when the leg was in the horizontal position or dorsiflexed. No treatment was advised.

ETIOLOGY

Muscle hernias occur predominantly in males, only one of the cases found in the literature being in the female,[12] due probably to the increased susceptibility of the male to injury and their greater muscular activity compared to the female.

With a few exceptions all the cases reported were observed in military personnel. However, in every instance in our series and in many instances in those reported in the literature when the duration is mentioned, the onset was in civilian life and they were diagnosed either only during routine military examinations or because of symptoms resulting from increased muscular use incident to military activities.

In our series, the ages varied between nineteen and thirty-eight years, corresponding roughly to the ages of the military personnel in whom they occurred. In the reported cases, the ages, when mentioned, were between nineteen and forty-two years.

They may be divided etiologically into the following types: (1) *Congenital;* (2) *traumatic:* (a) direct, due to direct injuries such as lacerations, operations, fractures, ulcers, gunshot wounds, or contusions; (b) indirect, due to acute muscle action; (3) *idiopathic or spontaneous,* probably due to: (a) muscle hyperdevelopment, (b) congenital weakness, or (c) increased muscular activity.

Actual congenital defects have been suggested by Lewis[13] and others as a possible etiologic factor, but we have not observed any and have been unable to find reports of cases in which the condition became apparent early enough in life to suggest this etiology. Localized congenital weakness may, however, be a predisposing factor in the production of the spontaneous type.

Direct trauma was responsible for the defect in eighteen of the 146 cases in which the etiology was given. Etiologic

trauma in our cases included a simple fracture, an ununited fracture treated surgically and an infected laceration by an axe. Those mentioned in the literature were lacerations, contusions, fractures, operations, ulcers, and penetrating foreign bodies such as bullets and hooks, all of which were traumas which produced a fascial defect either not repaired or which, when repaired, failed to heal because of supervening infection or for other reasons.

A small group arising as a result of trauma appears suddenly following a single, severe, indirect muscle strain which ruptures the overlying fascia and immediately results in hernia. Two such instances were observed by McWilliams[14] in participants in a game of "Irish Bowl." These developed herniation of the adductor longus muscle when strong adduction of the leg was suddenly and forcibly arrested during the course of the game.

The idiopathic group or those which develop insidiously without direct trauma, are relatively frequent, although of less clinical significance. One hundred twenty-eight of 146 cases in which the etiology was given belong to this group. They are observed usually in individuals who at some time preceding the onset engaged in strenuous activities, such as tennis, football, hunting, heavy lifting, or mountain climbing. Pichon, observed their occurrence in thirty-nine out of 217 Alpine soldiers. Congenital defects or weaknesses, particularly at the site of penetration of fascia by nerves or vessels, undoubtedly act as a predisposing and localizing factor as is suggested by their frequent symmetrical occurrence and the predilection of these hernias for certain positions in the leg, notably near the site of the emergence of blood vessels and the superficial peroneal nerve (Fig. 7) through the tibial fascia. Sherry in operating on these hernias, demonstrated the superficial peroneal nerve emerging through the fascia at the proximal portion of the hernial defect. Increased muscle volume, due to hypertrophy following increased muscular activity, was suggested by Ihde as the activating etiologic factor. Their frequent observation in military personnel suggests that this factor, together with the strain of the increased activity itself, is of etiologic importance. Typhoid fever was also mentioned by Sherry as a possible etiologic factor; reports of such cases were not found.

SYMPTOMS AND FINDINGS

The clinical picture of muscle hernia is typically the presence of one or more circumscribed swellings which vary in size or disappear depending upon the position of the part involved and the state of contraction of the underlying muscle. There is associated pain and tenderness which is usually moderate to mild or may be entirely absent. They occur predominantly in males and may be situated on any portion of the body in which fascia overlies muscle tissue.

The condition has been reported in association with many of the more active muscles, among the most frequently mentioned being the tibialis anticus, biceps and triceps, adductors of the thigh, gastrocnemius, rectus abdominis, peroneus brevis, rectus femoris, vastus lateralis, and the muscles of the back.

In those due to direct trauma, there is a history of an injury such as a laceration, fracture, operation, gunshot wound, contusion, or ulceration. Repair of the original traumatic defect may not have been accomplished or if accomplished may have been complicated by infection and delayed healing. Immediately or some time after healing, the swelling appears with gradual enlargement until it attains its maximum size which may vary up to 5 or 6 or more cm. in diameter. It is semifluctuant, uniform in consistency and completely or partially disappears when the limb is placed in a horizontal position and usually when the involved muscle is contracted; it increases in size when the limb is dependent and usually when the involved muscle is relaxed. It is completely or partially reducible with pressure, reveal-

ing a palpable defect sharply outlined in the fascia through which the muscle protrudes.

The variation in size of the hernia does not invariably bear this constant relationship to the state of contraction of the underlying muscle, but varies depending upon its proximity to the attachments of the muscle, whether the underlying muscle is predominently muscle tissue or tendon, and perhaps as Ihde suggested, upon its relation to the physiologic center of the muscle. In Case IX of the present series, the hernia was situated close to the tibial border and did not vary greatly in size with dorsi- and plantar flexion, probably because of its situation over the site of the muscle attachment at the tibial border. In Case IV likewise, there is less variation in size with dorsi- and plantar flexion of the foot but here the defect overlay the more tendinous portion of the muscle. When adhesions are present between the fascia and the muscle, variation in size may be less marked with change in position, and reduction may be incomplete with pressure; when there are adhesions between the muscle and the overlying skin, the latter moves visibly with contraction and relaxation of the muscle, and there may even be a dimpling or depression coincident with muscle contraction.

There may be no discomfort whatever or local aching of variable severity may be present, sometimes with radiation along the course of the muscle, aggravated by prolonged walking or strenuous exercise. Sometimes the discomfort may be severe enough to be disabling; cramping in the leg muscles is present in some instances. Tenderness is very slight or absent. Aspiration of the tumor yields negative results.

When the etiologic agent is indirect trauma, the patient gives a history of the immediate appearance of a painful tumor when strong contraction of the involved muscle is suddenly halted. Such a history is also typical of a muscle rupture but in the latter instance there is no palpable defect in the fascia.

Those hernias not due to trauma are typically smaller in size, varying from 3 mm. to 1 or 2 cm. in diameter. In some instances they are solitary, more often multiple or bilateral. As many as six were observed in one patient in our series and Kitchin and Richmond reported one patient who presented seventeen hernias.

The onset may be entirely unnoticed or there may be swellings which at first come and go, gradually becoming more persistent, especially after long standing or excessive walking. There may be no associated discomfort or there may be increased fatigability or a slight to moderate degree of local discomfort, leg pain or muscle cramping, always more marked after muscular exercise. Variations in size and reducibility are dependent upon the same factors which influence the hernias due to direct trauma.

DIAGNOSIS

The diagnosis of muscle hernias in the leg is not difficult if the condition is kept in mind when confronted with one or several semi-fluctuant swellings, associated with slight or moderate aching or increased fatigability. The swelling varies in size with position of the limb, and the state of contractility of the underlying muscle and reduction on pressure reveals a palpable fascial defect. Aspiration yields negative results.

DIFFERENTIAL DIAGNOSIS

Muscle hernia in the leg is most often mistaken for a varicosity and even after an unsuccessful aspiration it may go unrecognized. The smaller hernias and varicosities present similarities such as disappearance when the leg is horizontal and reappearance when the leg is vertical, as well as compressibility; but when a muscle hernia is compressed the edges of the fascial defect can usually be distinctly palpated, and the swelling disappears and reappears when the muscle involved is flexed and relaxed. Muscle hernias are

usually round and frequently solitary; and even when several exist, one above the other, they do not present the continuity or the discoloration of the overlying skin which characterize a varicose vein. Aspiration of blood from a varicosity is conclusive.

An arteriovenous aneurysm is characterized by a thrill and bruit, absence of the static changes characteristic of a muscle hernia, absence of changes in size with flexion and extension of the muscle, and finally, blood can be aspirated from the aneurysm.

Localized masses of varicosities and deep-seated angiomas usually present discoloration of the overlying skin, palpability of multiple vessels, the lack of changes in size with muscle contraction and relaxation and the lack of fascial defect found on compression when a hernia is reduced.

Muscle rupture or pseudohernia, presents a swelling which becomes prominent when the involved muscle is contracted and fascial defect is not palpable. The size of a muscle rupture does not diminish with the passive change in position of the leg from the vertical to the horizontal. The history of onset is similar to that of only one type of muscle hernia, namely, that due to indirect trauma or muscle action.

Lipomas, myomas, cysts, and other tumors may be confused with hernias when the involved muscle is not readily reducible because of adhesions. In the latter, however, there is at least partial disappearance when the leg is elevated to the horizontal and the fascial defect can still be palpated, beyond the borders of which the protruding muscle cannot be mobilized.

TREATMENT

When muscle hernias are not large or when asymptomatic, treatment is not indicated. Those which have symptoms not due to other causes, or are large or deforming, should be treated surgically unless contraindicated by age or associated conditions.

The first step in any type of surgical repair consists of the careful exposure of the entire fascial defect, complete mobilization and reduction of the herniated muscle, careful denudation of the fascia well back from the edges of the defect and accurate hemostasis. The simplest surgical procedure is closure by overlapping and suture of the edges of the defect, preferably with cotton or silk suture. This type of repair is applicable when the defect is small and the laxity of the borders permits their ready approximation.

When the defect is large and the degree of laxity of the fascia surrounding the defect does not permit closure by simple approximation, some plastic procedure, usually some type of fascia transplant is necessary. A continuous or interrupted lateral incision in the fascia, preferably near the line of the fascial attachment where other hernias are not apt to occur, may permit a sufficient degree of mobilization of the fascial borders to accomplish overlapping and closure, or may reduce the width of a larger defect and simplify fascial repair. (Fig. 4.) Frequently because of the tautness of the fascia, such a procedure is ineffective or accomplishes only partial closure as noted by Hartzell and in our second case, and then repair is best accomplished by a fascial transplant (Fig. 2) or by repair with narrow strips of fascia woven in such a manner as to repair the defect. (Fig. 5.) More efficient coverage may be obtained by using multiple, interrupted, fine cotton or silk sutures not only to anchor the strips at their passage through the fascial borders but also to spread them out and attach them to each other. These fascial strips are conveniently obtained from the fascia lata either by using a fascia stripper (Masson[15]) or by direct excision, and may be threaded into any needle with a sufficiently large eye. Undue tension should be avoided; and when reduction is not readily accomplished due to excessive volume, a portion or all

of the muscle may be excised as was recommended by McWilliams and Ihde. Rarely when the muscle cannot be reduced and is herniated extensively, the entire muscle may be excised and the defect closed as was done by McWilliams in a case of hernia of the adductor of the thigh. The fascia and all exposed surfaces should be protected with warm saline applications as constantly as possible during the operation.

Elastic pressure dressings, with immobilization in a complete or partial cast is carried out for about fourteen days, and walking is permitted after twenty-one days.

One patient with bilateral hernia was treated by Schmier[16] with injection of sodium morrhuate. There was complete relief from symptoms and disappearance of hernia for one year, then recurrence which cleared up after a second series of injections. This type of treatment may be tried in the smaller type of hernia when surgery is not desirable and symptoms are mild.

PROGNOSIS

Muscle hernias of the leg usually enlarge primarily for a relatively short period of time and then remain stationary in size. The symptoms are usually mild or moderate; but when there is excessive marching or exercise, discomfort may be aggravated and at times severe. Complications are rare; adhesions may aggravate the symptoms, very rarely strangulation may occur, as in the case reported by Conwell and Alldridge.

Incarceration may occur and the hernia become non-reducible as in McWilliams' patient. Hemorrhage has rarely occurred preceding or coincident with the appearance of the hernia but has not been observed as a complication.

Recurrences after operation have been reported especially when an attempt has been made to approximate the edges under tension and when infection has occurred as a complication of operation.

SUMMARY

Twelve patients with muscle hernias of the leg are presented. Three had large, solitary hernias of the tibialis anticus muscle, all due to direct trauma and two of which had symptoms severe enough to justify surgical repair which was successfully accomplished by fascial transplant. Nine patients had multiple small hernias which developed spontaneously with possible congenital weakness as a predisposing factor in some.

The literature dealing with muscle hernias is comparatively scant. An incomplete review reveals 163 cases of muscle hernias of the leg reported, including the twelve in the present report.

CONCLUSIONS

1. Muscle hernias of the leg are not of infrequent occurrence, particularly in active young males as represented by soldiers; they are most often recognized when muscular activity is increased.

2. Hernias of muscle of the leg are characterized by a soft, semi-fluctuant swelling which increases in size when the limb is dependent or the muscle is relaxed and decreases in size or disappears when the leg is passively elevated and usually when the muscle involved is contracted. It is reducible on pressure when a distinct fascial defect can be palpated.

3. There are three types: those due presumably to congenital defects, none of which were observed; those due to direct trauma, as fractures, lacerations and operations or to indirect muscle violence. These are usually single, large, and produce symptoms for which surgery is indicated. Those of the third or idiopathic type appear spontaneously, particularly after muscular activity is increased. They are usually small, often multiple, present less severe or no symptoms, and frequently require no treatment. They are apparently quite frequent, especially among young, active males.

4. Differentiation between muscle hernias and varicosities is most often con-

fusing. Other conditions to be differentiated are localized varicose veins, lipoma, angioma, and other tumors.

5. Surgical treatment, when indicated, consists of reduction of the herniated muscle and repair of the defect, usually by fascia transplant or suture. The results are usually good.

6. The importance of careful repair of fascial defects arising from trauma or after operation, in order to prevent later development of hernia, is emphasized.

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GREATER EFFICIENCY IN STEAM PRESSURE STERILIZATION OF SURGICAL SUPPLIES

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ATTENTION is called to some principles of physics and bacteriology. It is suggested that by taking greater advantage of some of these, the speed and accuracy of our surgical autoclaves may be increased.

Numerous investigators have worked to determine the amount of heat which must be applied to attain complete sterilization. Baking an object with dry heat at not less than 150°C. (300°F.) for a period of one hour is considered a reliable procedure for sterilizing the surface of an object (Zinsser and Bayne-Jones 1939). This, however, tends to destroy rubber goods and damages many fabrics. Penetration within wrapped bundles is unreliable. "Contact with ten pounds of saturated steam will probably kill all surgically significant spores within six minutes and should even destroy the highly resistant spores of Clostridium botulinum within 20 minutes. When the pressure of saturated steam is increased to 15 pounds, complete sterilization should be obtained in approximately one-third of the times mentioned above." (Hoyt, Chaney, and Cavell, 1938.) At sterilizing temperatures, liquid water itself seems to have antiseptic properties so that bacteria are destroyed more rapidly when they are wet. They may survive considerable exposure to similar temperature in the dry state. Superheated steam is of no more value as a sterilizing agent than hot air because it tends to dry the objects with which it comes in contact. (By the time it is cool enough to condense it has ceased to be superheated.)

The effect of dry heat on the nonsporulating bacteria was studied. A mixed suspension of Streptococcus pyogenes and of hemolytic staphylococcus aureus, which had been recovered from infected wounds, was used to wet the inside of ten small glass test tubes. These were dried in the incubator and then sealed by fusing the open end in a flame. Three tubes were heated in an autoclave at 121°C. for twenty minutes and three for forty minutes. Four tubes were used as controls without heating. Both organisms were recovered from each of the tubes. When wet these organisms are killed within one minute at that temperature. This emphasizes the importance of moisture in sterilization.

Spores of Clostridium oedematiens are considered by a number of observers to be the most heat resistant of any of the organisms of surgical importance (Hoyt, 1934). Previous drying does not appear to increase the resistance of bacterial spores to the action of heat in the presence of saturated steam (Esty and Meyer, 1922). The following thermal death times were determined for direct contact with saturated steam by Hoyt, Chaney, and Cavell (1938).

	Cl. Botulinum A., Minutes	Cl. oedematiens, Minutes
6 pounds saturated steam, 110°	Over 30	10
10 pounds saturated steam, 115°	10	4
15 pounds saturated steam, 121°	4	1

These observations and findings indicate that the most resistant spores of the known pathogenic bacteria are destroyed by exposure to moist steam at a temperature of 121°C. (250°F.) for periods of one to four minutes. If all pathogenic bacteria can be destroyed in less than five minutes, and

probably within one minute, what is to be gained by applying the sterilizing agent for a longer time? Doubling this time to ten minutes should provide more than 100 per cent margin of safety if it were certain that every spore had received the full treatment. The only excuse for any time longer than this is to provide time to allow the sterilizing agent to penetrate to the most hidden bacterium to a degree which will be effective. If diffusion and convection are depended upon to secure penetration of steam to the innermost folds of a large pack of sheets, prolonged periods of sixty to ninety minutes may be required to assure sterilization. A method of assuring that pure saturated steam under pressure is promptly applied to the most remote surface within the material to be sterilized should greatly shorten the time needed to produce complete sterilization.

The method whereby an object being sterilized attains sterilizing temperature is worthy of consideration. In a space occupied entirely by steam, the total gas pressure and the water vapor pressure are identical. At a water vapor pressure of thirty pounds per square inch (representing pure steam with fifteen pounds gauge pressure where atmospheric pressure is fifteen pounds) the temperature cannot be less than 121°C. (250°F).

Any object in this atmosphere which has a temperature less than 121°C. will absorb heat from the steam which rapidly condenses upon its surface until it has attained a temperature of 121°C. During this process of vapor condensation, the pressure upon the surface of the object will tend to be lowered. Steam from the surrounding space will flow toward the object. The process of condensation will continue, and the temperature of the object will rise until an equilibrium of temperature and pressure has been re-established. If the atmosphere in the chamber is composed partially of steam and partially of air, condensation of steam upon the surface of the cold object will cause a similar tendency for its temperature to be raised and for the surrounding gases to flow toward the object. However, as this process continues, the ratio of air to steam in the immediate vicinity of the object will be greatly increased. This increase will be due to the fact that the steam will condense upon the surface and trickle away as water, whereas the air which approaches the object with the steam cannot be condensed and will tend to form a blanket of air upon its surface. For this reason heavy objects which have considerable thermal inertia should be exposed to the steam in the chamber, without cover, so that convection can dissipate this air blanket, which might otherwise be held in the meshes of the surrounding fabric. Air tends to accumulate toward the center of a pack in an autoclave in an atmosphere of part air and part steam, especially in the case of a large pack of tightly folded linen. This is partly because of the fact that steam is absorbed as water by the cold linen, leaving the air to occupy the space between the fibers of the fabric. To overcome this difficulty and assure adequate sterilization of all fibers within the pack, either of two courses may be followed. Much time may be allowed in the hope that by diffusion steam will find its way to the center and that by conduction sufficient heat will penetrate to the center of the pack. This method of hopeful waiting involves much uncertainty and a considerable margin of time must be allowed for safety's sake.

The alternative course is actually to remove the air forcibly from the pack and replace it with steam, maintain that steam at a known pressure for a known length of time, and then terminate the sterilizing procedure with confidence that sterilization is complete. By elimination of guess work as to when the innermost part of the pack reaches sterilizing temperature, those long periods of hopeful waiting are eliminated, saving much damage to linen and other goods being sterilized.

The sterilization of rubber gloves presents a problem of its own. The sterilization of the inner surface of a rubber glove is

equally as important as the sterilization of the exterior because of the possibility of tearing of the glove while it is being used. Rubber deteriorates during long exposure to sterilizing temperatures. Gloves are powdered inside and out to prevent adhesion between the surfaces in contact. The powder and residual air within the glove tend to absorb moisture. The glove is heated by steam in contact with its exterior surface in much the same way that the wall of the autoclave chamber is heated by the jacket, thereby preventing precipitation of moisture upon the interior of the glove. Rapid autoclave sterilization is dependent upon contact with saturated steam. If permeating by steam of the entire space within a rubber glove is dependent upon convection and diffusion, it is possible that the space within the finger of a powdered glove may sometimes fail to become moist. Therefore, it becomes obvious that the sterilization of the interior of a glove is a more positive procedure and the length of exposure required for complete sterilization is reduced when steps have been taken actually to remove the air from the glove and to replace it with steam.

Hypodermic needles are frequently placed in glass tubes for sterilization. If the end of the tube is occluded by a rubber or other impervious stopper, sterilization of the needle in an autoclave cannot reliably be accomplished, because the interior of the tube would remain dry even though it attained sterilizing temperature. Closing the end of the tube with a porous cotton plug permits air to leave the tube and steam to enter it. Active replacement of air by steam within the tube insures prompt and thorough sterilization.

The sterilization of solutions within the autoclave presents a still different problem. Heat is transmitted to a solution through a metal wall very effectively and rapidly. A vessel with a thin glass wall will permit fairly rapid heating of its contents. Because glass is a poor conductive medium, the heavier the walls of a glass vessel the more slowly the heat will reach the liquid within. No advantage is believed to be gained by pressure changes in the heating of solutions. The pressure must be reduced very slowly after sterilization of liquids to minimize foaming and loss of solution by boiling over.

The preparation of vaseline gauze for wound dressing requires special consideration. Lang and Dean (1934) found that "Destruction of spores by heat in an oil medium may be said to embrace conditions existing in dry heat sterilization." They found that oil coated spores which had been heated for periods much exceeding that required to kill the spores exposed to moisture, were still viable when the oil was removed. It is, therefore, obvious that the only safe procedure is to sterilize the gauze and its container with steam, and then add vaseline or petrolatum to be melted into the sterile gauze by subsequent heating. This requires, in addition, that the petrolatum be handled in such a way as to avoid bacterial contamination, from the time it is prepared at the refinery until it is used in the surgical dressing room. Petrolatum which has been much handled, as by rubbing boric acid or other matter into it, does not seem to fulfill these specifications. Methods for sterilizing such mixtures after preparation have not come to my attention. In practice vaseline gauze causes almost no trouble although its preparation rarely meets these standards. This may be due to an enveloping action of the vaseline which may prevent bacteria in the gauze from reaching the wound surface. The matter deserves attention.

Sterilizing of uncovered solid objects, such as instruments upon an open tray, is accomplished rapidly and effectively by simple exposure to saturated steam under pressure. They contain no air to be displaced.

The principle of exchanging air for steam in the autoclave chamber may be described as follows: The outer jacket of the autoclave is heated with steam under pressure, the charge is placed in this autoclave and the door closed. Steam is ad-

mitted to the chamber. The steam entering the chamber strikes against a baffle which causes it to spread in a layer occupying the top portion of the chamber. Steam is lighter than the cooler air which previously occupied the chamber. As the steam continues to enter the chamber the layer of steam becomes progressively deeper pushing the air downward. The air escapes freely through the drain at the bottom of the chamber until live steam begins coming through the drain and closes the automatic drainage valve. At this original filling of the chamber with steam probably more than 95 per cent, of the air in the chamber is replaced by steam and some air may continue to work its way to the drainage valve during the sterilization process. Maintaining two distinct layers of gas within the chamber, while the air is being displaced, depends upon the steam being lighter than air. Therefore, it is best to charge the sterilizer with steam immediately after closing the door before the air within the sterilizer has had time to absorb heat from the walls of the chamber. Thus, in a modern autoclave, air is quickly and effectively evacuated from the sterilizing chamber itself.

The positive application of saturated steam to all surfaces within a pack, closed drum, rubber glove, or glass tube is not reliably accomplished by the method of gravity displacement previously described for an open autoclave chamber. Rather, it is safer actually to remove the air and replace it with steam. A step-by-step description of this procedure for the removal of air follows: The air in the chamber about the object to be sterilized is replaced with steam at the original filling of the autoclave chamber. Some steam will penetrate the object by gravity and diffusion, but this will be disregarded because of the lack of certainty with which it occurs.

1. If the pressure of the steam in the chamber is increased to fifteen pounds (gauge), the steam will have an absolute pressure of approximately two atmospheres. At this time the air within the object will have been compressed to half its volume so that steam will occupy half the gas space within the object. A considerable amount of diffusion and mixture of steam and air will occur in the area of contact between the steam and air. Some water will have condensed upon the surfaces exposed to the steam.

2. Steam is allowed to escape from the chamber until the gauge pressure reaches 0. During this time half the content of air and steam within the object will have escaped from the object by expansion.

3. The pressure within the chamber is further reduced by the use of the vacuum device to one-half atmosphere (minus 15) inches of mercury. At this point about one-half of the steam air mixture which was in the object at 0 pressure has been removed by further expansion. During these expansions a part of the moisture which had condensed upon the surfaces within the object evaporates. This evaporation tends to follow the reduction of pressure so the water vapor, thereby produced within the object, tends further to flush the air from the spaces within the object. It will be noted that one-fourth (i.e., one-half of one-half) of the original air content of the object remains within the object at this time. (Because diffusion in the mixture of steam with air could not have been complete, the amount of the remainder of air must be considered approximate.)

4. Steam is now admitted to the chamber until the gauge pressure reaches fifteen pounds. It will be remembered that about one-fourth of the original content of air may be still in the pack.

5. If gas is again exhausted from the chamber to one-half atmosphere of pressure (minus 15 inches of vacuum) in a manner identical with that described in (2) and (3) above, three-fourths of the air remaining within the chamber is again removed. This leaves one-sixteenth of the original content of air.

6. The chamber is again filled with steam to fifteen pounds (gauge) pressure

and then evacuated to a pressure of minus 15 inches of mercury, this time leaving one-sixty-fourth of the original content of air within the package.

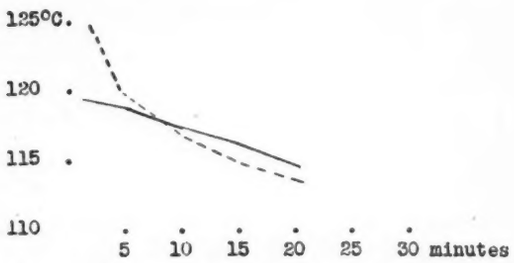

FIG. 1. Minutes required to cause complete change of color and/or melting of sterilizer control device at various temperatures. Solid line for "Diack" controls; broken line for "Sterilometers."

7. This change of pressure is repeated more times for larger, denser packs.

8. Steam is admitted to the chamber till a sterilizing pressure of fifteen or twenty pounds is obtained, where it is held for a period of ten minutes.

Simple devices which change color or shape at a known temperature have been commonly accepted as indicating whether sterilizing conditions have prevailed. The time required to effect two such sterilization control devices was determined by watching the temperature of the discharge pipe during exposure to steam in the autoclave. The results are shown on the accompanying graph. About seventy-five tests were made. Some variation in the individual controls was found. The end-point of "Diack" melting was found to vary from 113°C. to 119°C. for exposures of ten minutes. In one instance, six "Diack controls" were heated simultaneously in one loose cluster at 115°C. for fifteen minutes; one was melted, three were incompletely melted, and two showed no change. Greater constancy was found in the "Sterilometers." Both "sterilizer control" devices were subjected to repeated rapid alternations of steam pressure and vacuum without effect on their color or shape. It is assumed that each of these devices is a valuable and reliable aid in determining whether sterilizing temperature has been attained in the autoclave.

The following experiments demonstrate the effectiveness of alternation of steam pressure and vacuum in pumping residual air from even the most dense, tightly packed bundles of fabric, thereby attaining more rapid heat penetration.

Experiment No. 1. Eleven folded hospital sheets were rolled very tightly, making a dense bundle 20 cm. (8 in.) in diameter by 40 cm. (16 in.) in length. This was wrapped with paper. To melt "Diack" controls regularly in the center of such a roll by the conventional method of autoclaving required more than forty-five minutes exposure to steam at 121°C. In similar rolls, emptied of air* and then exposed to steam at 121°C., "Diack" controls were always melted within ten minutes. Spores of Clostridium botulinum were suspended in Thioglycolate culture broth and sealed in glass ampoules. These were wrapped in rolls identical with those described above. After removal of air,* one roll was exposed to steam at 121°C. for each of the following times: ten, seven and one-half, five, and three minutes. The ampoules were then incubated. No growth occurred in any of them, surprisingly not even in the one exposed for only three minutes. Other ampoules prepared in the same lot, but not subjected to autoclaving all produced Clostridium botulinum by incubation.

Experiment No. 2. A conventional sterilizing drum 25 cm. in diameter with side ports which can be slid open or closed was tested. Folded sheets were rolled very tightly and bound with string so that they formed a bundle which completely filled the drum from the bottom to the lid, and which required effort to force it into the drum. "Diack controls" were placed within this roll at intervals of 2 cm. from the circumference to the center. When

* In this group of tests air was evacuated by four pressure changes. Each change was from two atmospheres (fifteen pounds steam pressure) to one-half atmosphere (fifteen inches of mercury vacuum).

such a package was placed in the sterilizer with the lid raised about 2 cm. and the side ports opened, it was immediately autoclaved with a discharge temperature of 122°C. (252°F.) for forty-five minutes; wax in the controls was melted only to a depth of about 6 cm. The center of the drum had not attained a sterilizing temperature. Another drum prepared in an identical manner was placed in the autoclave with all ports and the lid closed. It was treated by four pressure changes, following which steam pressure with a temperature of 122°C. (252°F.) was maintained for ten minutes. The contents of this drum were examined and all Diack controls were

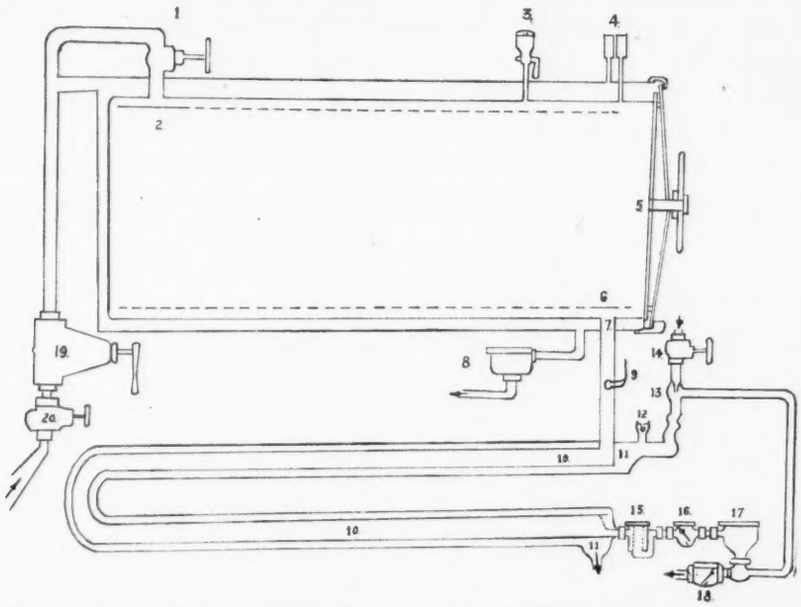

Fig. 2. Suggested modification of autoclave to facilitate rapid displacement of air with steam.

For an autoclave with a chamber capacity of 5,000 cu. in. (100 liters) the supply pipe should not have less than 5/8 inch (15 mm.) inside diameter. The pipe for evacuating the chamber should be 1 inch (25 mm.). "Bend" fittings should be used in lieu of L's to avoid sharp turns in these steam pipes. Liquid on the floor of the chamber should flow by gravity to outlet No. 7. 1, Steam inlet valve; 2, baffle to cause steam to form a layer in top of chamber, thus minimizing mixture with air while the cold air is being blown out; 3, cotton filtered air inlet valve to permit opening door after sterilization is complete; 4, gauges indicating jacket and chamber pressures; 5, a conventional lever-locking autoclave door; 6, baffle in floor of chamber to prevent objects within the chamber from blocking the free exit of air; 7, large unobstructed outlet opening; 8, automatic valve which permits escape of cold air and water from the jacket but closes when heated by live steam; 9, thermometer which indicates the temperature of gases being discharged from the chamber which are usually the coolest gases within the chamber; 10, inner condenser tube, "U" shaped to permit expansion and contraction without breaking the joints at the ends of the water jacket; 11, water-cooled condenser jacket so arranged that the jacket is drained completely by gravity except while suction pump is operating; thus, the air in the empty condenser jacket acts to insulate its inner tube during the sterilizing period; 12, overflow device permitting escape of air; 13, water jet type suction pump; 14, valve to control suction pump; 15, screen to catch fibers which might clog the automatic valves; 16, check valve; 17, automatic valve which permits escape of cold air and water from the chamber but closes when heated by live steam; 18, check valve; 19, automatic pressure regulating valve to maintain constant pressure on steam supply line; 20, valve on main steam line; 21, safety valve, not shown in the diagram, at any point on jacket or supply line following the pressure regulator.

found to be melted, including one at the center of the pack.

Experiment No 3. An empty metal "lard" can, 45 cm. (18 in.) in diameter and 80 cm. (32 in.) in length, was tightly packed with muslin and the metal cover was fastened in place by tying it on with cord. Diack temperature indicators were inserted into the pack every 5 cm. from the top to the bottom. When completely packed and covered, the only remaining opening was the little crack between the lid and the end of the can, which averaged less than 1 mm. in width. The loaded and covered can was placed in the autoclave on its side and steam was alternately forced into and withdrawn from the can making four complete pressure changes, as rapidly as our equipment would permit, after which a temperature of 121°C. (250°F.) was maintained for ten minutes. The can was then removed from the sterilizer and its contents examined. The wax in each Diack tube was found to be melted, indicating that sterilizing temperature had been attained at the most inaccessible points within the can.

Experiment No. 4. One large heavy canvas linen conveyor bag which fully occupied the space within the chamber, 160 cm. long by 50 cm. in diameter, was placed in the autoclave and packed tightly with linen. Diack's sterilization controls were placed at regular intervals throughout this mass of linen to test the temperature attained at various depths and levels. The purse string closing the end of the bag was drawn closely leaving one opening about 10 cm. in diameter just inside the sterilizer door. The autoclave was filled with steam, four pressure changes were made to evacuate air from the bag and its contents, and steam pressure was maintained at a temperature of 122°C. (252°F.) for ten minutes. The bag was removed from the sterilizer and its contents examined for heat penetration and moisture. The wax in each of the Diack "controls" was found to be melted. Faint moisture was present in the layers of the fabric at all levels throughout the bag. This bag was re-packed in a similar manner and was subjected to one continuous exposure to steam for a total length of time equal to that required for the pumping out of air plus the sterilizing period. During this exposure about half the "Diacks" failed to melt.

DIRECTION FOR OPERATION OF AUTOCLAVE

1. Begin with all valves closed.
2. Open valve 20.
3. Set valve 19 to maintain desired pressure.
4. Place charge in chamber and close door 5.

TABLE OF SUGGESTED STERILIZATION TECHNIC

Dressings in very large dense packs	4 changes* plus 10 minutes†
Dressings in normal size packs in double muslin covers	2 changes plus 10 minutes
Fully loaded drums with double muslin liners	4 changes plus 10 minutes
Utensils, nested, in double muslin covers	4 changes plus 10 minutes
Utensils, single, in double muslin covers	2 changes plus 10 minutes
Instruments without cover held high in chamber	Direct exposure, 126°C. (260°F.) 5 minutes
Instruments in trays without cover	Direct exposure 121°C. for 10 minutes
Instruments wrapped for storage	2 changes plus 10 minutes
Rubber gloves in double muslin wrappers, not stacked	2 changes plus 10 minutes
Transfusion or intravenous sets or catheter trays	2 changes plus 10 minutes
Solution (1,000 cc. bottles or Baxter or Cutter Safti-flasks)	Direct exposure‡ for 20 minutes
Solutions (1,000–1,500 cc. flasks) (thin glass)	Direct exposure‡ for 15 minutes
Solutions (500 cc. flasks) (thin glass)	Direct exposure‡ for 12 minutes
Solutions (25–250 cc. flasks) (thin glass)	Direct exposure‡ for 10 minutes

* Each change represents evacuation of chamber from a gauge pressure of fifteen pounds or more to minus 15 inches of mercury vacuum and then refilling to fifteen pounds pressure with steam.

† "plus 10 minutes" means that the material to be sterilized will be subjected to steam at a temperature of 121°C. (250°F.) or more for ten minutes after the last change.

‡ Direct exposure, to saturated steam at a temperature of 121°C. with no alternation of pressure and vacuum before sterilization and slow reduction of pressure afterward.

5. Open valve 1. Watch until pressure within chamber ceases to rise, i.e. until hand of pressure gauge stops.*

6. Close valve 1 and open valve 14. Watch until pressure seems to cease to fall.

7. Close valve 14 and open valve 1. Wait until chamber is filled (i.e., until gauge can no longer be seen to move.)†

8. One complete pressure change has been accomplished. Steps 6 and 7 are repeated alternately and rapidly until the required number of pressure changes have been made.

9. After last pressure change allow valve 1 to remain open ten minutes.

10. Close 1 and open 14 and allow contents to dry as desired.

11. Close 14 and open valve 3 to admit air and allow door to be opened.

CONCLUSION

1. One to four minutes exposure to saturated steam at a temperature of 121°C. (250°F.) should destroy all pathogenic bacteria. Ten minutes such exposure should provide a liberal margin of safety.

2. Such exposure can be assured only by rapid thorough removal of air *before* exposure, thus permitting steam to reach every spore without delay. A method of removing air is discussed.

3. It is suggested that the common sterilizing room procedure, of hopefully waiting for air to be removed from the sterilizer contents by diffusion and by gravity, wastes time and is often ineffective.

4. It is believed that if very difficult objects can be penetrated and sterilized by this method, surely the usual type of surgical goods can certainly be rendered sterile by the same method.

5. This method of sterilization can be performed with any autoclave which is equipped with a vacuum device. If the autoclave can be rapidly filled and emptied, this method will save much time in the sterilization of supplies. It will materially reduce the deterioration of rubber and other goods being sterilized. Further study may show that the sterilizing period can be shortened even more.

* This sterilizing procedure can be performed with any modern surgical autoclave. The autoclave described above has been designed to reduce the time required for filling and emptying the chamber., viz., steps 6 and 7 above.

† If using a rapidly filling and emptying autoclave, hold this pressure for fifteen seconds for muslin wrapped packs and up to ninety seconds for very large dense packs with nearly impervious covers. It is more efficient to make an extra change of gas (steam) than to waste many minutes waiting for a slow autoclave to gain that last pound of pressure.

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THE HANDLING OF WAR CASUALTIES

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TWO factors detract from the value of reports on surgical experience in the first World War: changed methods of warfare which create new types of injuries, and the continuous progress of surgery responsible for modifications of old or introduction of new therapeutic measures. However, such reports are of great interest, first, because certain fundamental principles remain unchanged and, second, because an accumulation of data collected from personal experiences may pave the way to improvements in the treatment of war casualties.

It is in this spirit that the following report, based on four years' experience in field clearing stations and mobile evacuation hospitals is submitted, with the hope that the suggestions offered may be accepted as such or may lead to new developments.

It can not be too strongly emphasized, that the suggested therapeutic measures should not replace but rather supplement newer methods which had time enough to demonstrate their merits.

Naturally, no attempt has been made to cover the entire field of traumatic surgery, attention being paid chiefly to subjects infrequently mentioned in the literature.

CHEST INJURIES

Five complications deserve attention: hemothorax, tension pneumothorax, open pneumothorax, mediastinal emphysema and concomitant injury of abdominal organs.

In patients who show signs of a grave anemia, a reinfusion of the blood evacuated from the chest cavity may be considered, especially if no donor's blood or plasma is available. The danger of injecting a coagulum is minimal because the blood accumulating in the pleural cavity remains liquid. Three theories have been advanced to explain this phenomenon: (1) The pleural serosa is identical with the endothelium of blood vessels which maintains the blood in the liquid form. Anatomists disagree with this theory. (2) Respiratory movements of the diaphragm agitate the blood and defibrinate it. This theory does not explain the fact that blood remains liquid in injured articulations. (3) The pleural lining secretes an anticoagulating substance. This hypothesis has a great appeal although it has not yet been proved. As to the danger of contamination, experience shows it to be of no great importance if the customary precautions are taken.

A tension pneumothorax is usually caused by a valved opening in the lung which permits the entrance of air into the pleural cavity but not its exit. A thoracocentesis should be performed and a drain equipped with a perforated condom introduced.

If an open pneumothorax is caused by an extensive laceration of the thoracic wall, a prompt closure of the defect is essential to eliminate the respiratory embarrassment and the disastrous effect of mediastinal flutter. When approximation of the rib above and the rib below is not sufficient to cover the defect, the open, sucking wound may be closed with elastoplast, which, however, is usually not available in the combat zone. It was found that a very efficient occlusive dressing can be made from wax paper, salvaged from cartons containing *x*-ray films. Such paper can be collected from *x*-ray stations and kept in readiness at more advanced field stations. In emergency anything may be used to plug the opening, even with a

disregard for sterility. Dressings applied to the wound are apt to move and usually do not produce a sufficient occlusion. A more efficient way is to employ a dressing resembling the old Mikulicz pack: The center of a towel is introduced into the thoracic cavity and the bag created in this manner is stuffed with sponges or any other material available. The resulting dressing resembles a mushroom and is not easily expelled. The patient should be placed on the injured side in order to obtain pressure and to facilitate drainage as well as respirations on the normal side.

Mediastinal emphysema may result from an injury of the trachea or larger bronchi; occasionally it may be produced by a rupture of the lung underneath an intact visceral pleura. Tension pneumothorax may also be responsible for the same condition, recognizable by dyspnea, cyanosis, crepitation above the manubrium, dilatation of cervical veins and facial edema. *X*-ray findings are also characteristic. The condition calls for a short incision in the suprasternal notch, carried through the skin and platysma, and followed by a blunt dissection with the finger until the mediastinum is reached.

ABDOMEN

An abdominal injury may erroneously be diagnosed while in reality an injury to the intercostal nerves is responsible for abdominal pain. This type of injury may also cause tenderness, muscular rigidity and leukocytosis. Therefore, the inspection should not be limited to the abdomen, but the chest should be examined in every patient with pains in the abdominal region. As a rule, the rigidity is unilateral and there is no vomiting; furthermore, when a relaxation of abdominal muscles is produced by placing the patient on a backrest, the rigidity disappears within a short time. Conversely, presence of bile or gastrointestinal contents in fluid aspirated from the pleural cavity indicates an abdominal, or, more correctly, an abdominothoracic injury involving a hollow viscus.

It should be remembered that spinal injuries may produce referred abdominal pain and rigidity. No diagnosis of a contusion of the abdomen should be made without a thorough examination of the patient, including the chest and the spine.

Small perforations of the intestines should be sutured while an enteroenterostomy is indicated in more extensive injuries. Resection should be undertaken only in presence of extensive destruction or numerous perforations of intestinal loops, or segments devitalized by an injury of the mesentery. The surgeon may be inclined to eviscerate the abdomen in order to minimize the spilling of the gastrointestinal contents into the peritoneal cavity, but it should be remembered that patients with abdominal injuries stand the eventration poorly. For this reason inspected segments of the intestines should be immediately replaced into the peritoneal cavity before the search is continued.

Appendicitis can be simulated by a traumatic hematoma in the abdominal wall, caused by a contusion. Vice versa, the fact should be kept in mind that a patient who sustained a contusion of the abdomen may concurrently develop appendicitis which can be easily overlooked if the surgeon's thought is focused upon trauma only.

INJURIES OF THE THIGH

Injuries of the upper third of the thigh are less dangerous than injuries of the lower two-thirds because the bone lies relatively close to the surface and is therefore easily accessible. The hematoma which forms after an injury of the bone has a tendency to infection and formation of an abscess which spreads along the quadratus femoris and adductor minimus muscles or follows the course of the ileopsoas muscle. To avoid this complication and to release the interstitial tension which may interfere with the blood supply, it is advisable to

make a 10 to 15 cm. long incision on the lateral aspect of the thigh in order to evacuate the hematoma.

As a rule, injuries of the middle third of the thigh are much more serious because blood vessels located closely to the bone are exposed to an injury by bone fragments and because the bulky muscles are an easy prey to infection. For the aforementioned reasons a prophylactic incision on the lateral aspect of the thigh is indicated. No counterincision in the femoral trigonum should be made because the proximity of large blood vessels creates a danger of a secondary hemorrhage by arrosion.

In complete fracture of the lower third of the femur the lower fragment is usually tilted backward by the gastrocnemius muscle. If the extremity is placed on a straight splint, the traction of this muscle increases the posterior dislocation of the distal fragment of the femur, with a resulting danger of an injury of the femoral artery. To avoid this danger, the splint should be applied with the knee not in extension, but a flexion of about 135 degrees. Formation of an abscess in the popliteal space may be prevented by incisions on the medial and lateral sides of the thigh.

Such prophylactic measures are justified in view of the fact that at least 75 per cent of injuries of the femur under war conditions become infected.

It remains to be seen whether an early administration of sulfa drugs will prevent the occurrence of infections to such an extent that prophylactic incisions for evacuation of hematomas will prove superfluous.

In regard to amputations, adverse criticism is anticipated concerning the unorthodox preference of flaps to a guillotine amputation. Nevertheless, formation of flaps offers the great advantage of saving more tissues. One point cannot be stressed too much, namely, that the flaps should not be sutured.

Flexion and abduction contractures, frequently following an amputation of the thigh, interfere with walking. Therefore, the elevation of the stump and flexion to 45 degrees after the operation should be abandoned as soon as possible. Contractures can be counteracted to a great extent by placing the patient on his abdomen at frequent intervals. If a contracture developed and cannot be corrected by active or passive motions, an oblique incision through the gluteus medius, fascia lata and the iliotibial tract will elongate the shrunken tissues. After this operation both thighs should be approximated by a heavy canvas binder placed around the hips.

GAS GANGRENE

An early diagnostic sign is the dissociation of pulse and temperature, the pulse being rapid out of proportion.

The impairment of circulation is due to two factors: (1) compression of blood vessels by toxic edema underneath the tense aponeurosis, and (2) stimulation of terminal branches of vasoconstrictor fibers in the blood vessel walls by toxic products.

To eliminate the mechanical factor of compression and to drain the edematous fluid, longitudinal incisions are made through the sheaths surrounding blood vessels and nerves. For instance, the sheath of the femoral artery can be opened in Hunter's canal and that of the posterior tibial artery behind the internal malleous. In addition to it, overlapping transverse incisions above the edematous area limit diffusion. To avoid pressure necrosis, wide strips of gauze placed around bundles of muscles can be attached to a wire type splint. Such separation of muscles keeps the wound open.

As to vasomotor reflexes, they can be suppressed by novocaine injections in suitable places such as Scarpa's triangle or the axilla. Intramuscular injections of 0.001 mg. of eserine sulfate diminish the tonus of sympathetic nerves.

A slow intravenous injection of gas gangrene serum, preceded by a subcutaneous adrenalin injection, is a heroic measure, to be used in grave cases.

It goes without saying that all these measures should be supplemented by the customary modern treatment of gas gangrene.

Bacillus coli, proteus and several non-pathogenic anaerobic bacteria may produce gas in phlegmones or abscesses which are much more benign than gas gangrene and do not require radical treatment awarded the latter.

It is worth while remembering that tetanus and gas gangrene bacilli may remain dormant around foreign bodies a long time and that the infection may flare up following the attempt to remove them. It is wise to administer serum before the operation, no matter how much time elapsed since the injury.

GANGRENE

It is noteworthy that typhus is a factor predisposing to gangrene of lower extremities. Probably the exanthematic typhus has a toxic effect on vasomotor centers. If the outside temperature is low, patients with typhus should be watched closely; if the pulse of the dorsalis pedis artery is weak, a heat cradle should be applied, because the cold weather, with the typhus as a contributing factor, may produce a vasoconstriction sufficient to cause gangrene.

KNEE INJURIES

An infection following a knee injury may be confined to the upper recessus. In such case a rubber drain may be introduced posteriorly and the articulation filled with a 0.5 per cent novocaine solution to which 2 cc. of Chlumsky's solution (acid. carbol. liq. 30.0, camphor. 60.0, alcoh. absol. 10.0) has been added. The drain is plugged with a cork and the injured extremity splinted. The solution is changed daily. An empyema developing in the lower posterior recessus is a much more serious condition because the intra-articular ligamentary apparatus is easily involved and the edema spreads to the upper and lower leg. If the trauma is not very extensive and the intra-articular ligamentary apparatus is still preserved, a resection of the articulation may be replaced by a more conservative procedure, namely, a resection of the condyles through separate incisions at their base, supplemented by an anterior arthrotomy. In this manner satisfactory drainage is obtained, the ligamentary apparatus is preserved and no shortening of the extremity follows the operation. Drains are inserted and the leg is placed in a body cast.

An extensive injury requires a partial resection of the articulation. A high temperature following the resection and persisting two or three weeks, but without any other signs of septicemia, is not an indication for an amputation. On the other hand, the continuation of a septic condition, lack of appetite and persistence of pains call for an amputation within one week after the resection.

COLD EXPOSURE

According to the degree of chilling and moisture, various terms have been applied such as immersion foot, trench foot, frostbite, etc., although the underlying condition is the same.

No oil or any other grease should be applied to leather shoes because it increases the conductivity of leather. Wrapping the feet into few layers of newspaper, before they are placed into the shoes, is a good prophylactic measure.

The mechanism of edema may be explained in the following manner: Prolonged exposure to intensive cold causes a reflex vasoconstriction with a resulting ischemia which in turn is followed by a local anoxemia. The interference with the cellular metabolism leads to an accumulation of carbon dioxide and lactic acid in the tissues. The shift of the hydrogen ion concentration to the acid side causes changes in the osmotic conditions in the tissues which, together with increased permeability of capillaries, produces edema. Furthermore, the abnormal acidity and changes in the osmotic

pressure lead to changes in the electric potentials of plasma proteins in the blood, facilitating agglutination and thrombus formation in the capillaries and veins. In addition to the disturbances of the acid-base equilibrium, the retardation of the blood current contributes to formation of thrombi in the capillaries and venules.

As to the treatment, the popular method of rubbing the frozen parts with snow carries the danger of secondary infection. A gentle kneeding of the adjoining, not frozen parts through soft cloths is preferable. The frozen parts may be placed in water 6° to 10°C. (42.8° to 50.0°F.) gradually increasing the temperature to 15°C. (59.0°F.) It is advantageous to apply external and internal heat as soon as possible to the rest of the body.

A rapid application of heat to the frozen part is harmful because it causes vasoparalysis, with a resulting stasis and transudation of plasma.

Among supportive measures, intravenous injections of papaverine or aminophylline deserve attention because they have a vasodilating effect. Conduction anesthesia with novocaine without adrenalin also may be tried because it stops pain and suppresses the action of the autonomic nerves, thus inducing vasodilatation. For the same purpose paravertebral novocaine injection may be given. Rectal instillation of 5 per cent glucose solution with addition of alcohol is indicated in severe cases.

Wet ulcers were found to be healing quicker after application of gentian violet in powder form than after the employment of any other method of treatment.

NERVE AND TENDON INJURIES

No attempt should be made to suture injured nerves or tendons in contaminated areas. Everybody familiar with traumatic surgery knows the difficulty of finding the severed ends of nerves or tendons in old scars. To facilitate this task at the subsequent operation, a simple expedient of transfixing the proximal and distal portions of the injured structures with black silk is highly recommended. The sutures are left long, protruding through the wound, or can be carried through the margins of the skin.

Case Reports

TOTAL PNEUMONECTOMY FOR BENIGN BRONCHIAL ADENOMA*

CASE REPORT

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HANOVER, NEW HAMPSHIRE

THOUGH bronchial adenoma has become definitely separated from bronchial cancer and other benign bronchial tumors, some aspects of the life history of this neoplasm are still largely obscure. It is well known that the lesion is slowly progressive, occurs in the majority of cases in women in the third or fourth decade of life, and that in most instances the chief danger lies in the effects of bronchial obstruction produced by the growth. There are, however, varying opinions as to the origin and pathogenesis of this tumor. Originally confused with cancer or sarcoma (early 1930's), it was later considered entirely benign. Of late, there has been a swing toward the viewpoint that the tumor is usually benign but may become malignant. Thus, in 1938, Womack and Graham[1] stated that in their opinion it is a mixed tumor and may at any time become malignant and metastasize. Basing their decision largely on the pleomorphism of the growth, these authors

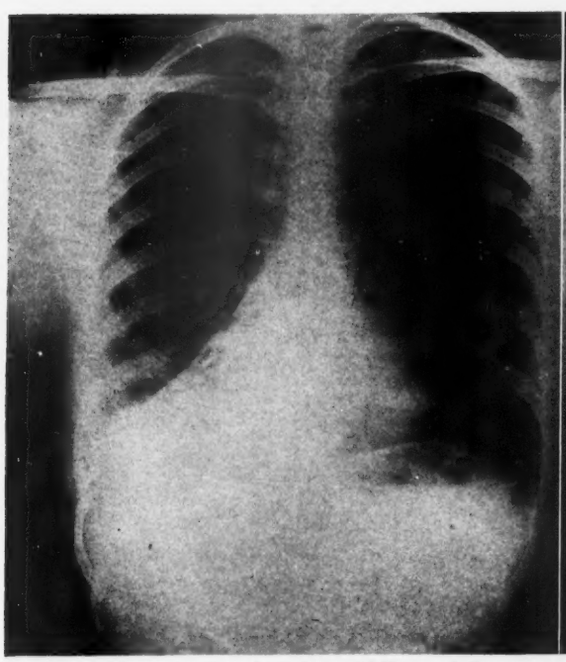

FIG. 1. Atelectasis of right middle and lower lobes. July, 1939.

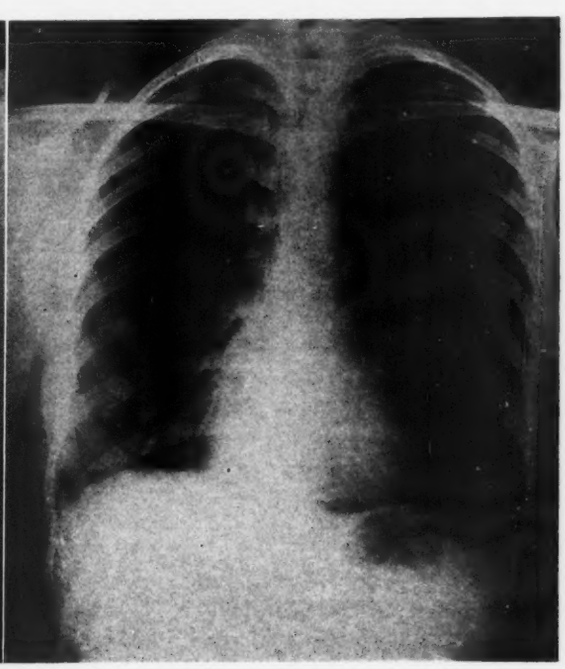

FIG. 2. *X*-ray taken one month after Figure 1. Atelectasis has disappeared but there are increased lung markings in right lower lung field.

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† On leave of absence.

expressed the belief that this lesion is the underlying factor in pulmonary sarcoma, oat-cell carcinoma of the lung, and many

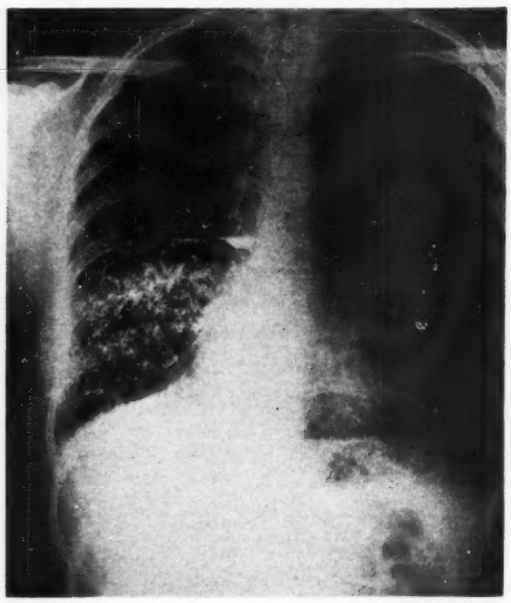

FIG. 3. Bronchographic demonstration of obstruction in right lower and middle lobe bronchi.

of the bronchial adenocarcinomas. Further corroboration of the viewpoint that malignancy may arise in these tumors was given in an article by Adams, Steiner and Block,[2] in 1942, and again by Anderson,[3] in 1943. These authors found definite, distant, metastatic foci in three cases of so-called bronchial adenoma. Though this is probably a rare occurrence, the possibility of malignant change in any given instance of adenoma would certainly modify the type of therapy proposed in such cases, and the frequently reported treatment of these lesions by endobronchial removal often combined with deep *x*-ray therapy or direct radium implantation should certainly be questioned. In late years there have been a good many surgeons who have reached the viewpoint that sooner or later pulmonary resection will have to be done in the majority of cases even without the question of malignancy because, even though the tumor is apparently eradicated by numerous bronchoscopic manipulations, the patient continues to carry an infected and often useless lung distal to the site of the tumor.

Another contraindication to bronchoscopic removal is the fact that the adenoma is often not restricted to the lumen and wall of the bronchus, but penetrates the wall and expands extrabronchially as well, so that it is beyond the reach of the bronchoscopist. These facts were emphasized by Stephens and Goldman,[4] in 1941. These authors have summarized the literature on adenomas, as has Foster-Carter.[5] The latter found one hundred recorded cases up to the time of his publication (1941).

The condition is uncommon and the results of therapy have not been determined over a long period of time in many individuals so that it seems justifiable to report all cases which occur in order that the knowledge thus accumulated will afford a therapeutic guide and provide a better understanding of the natural history of this lesion.

CASE REPORT

The patient is a married woman who was admitted to the Mary Hitchcock Memorial Hospital in January, 1940, at the age of twenty-seven. A history was obtained of a long siege with pneumonia five years before, followed by an interval of good health. In May, 1939, she caught cold and developed a non-productive cough associated with a low grade fever. Several days after the onset, right chest pain appeared and the diagnosis was made by her doctor of pleurisy with effusion. After an illness of fifteen days, the cough entirely disappeared. In July, 1939, at the insistence of the telephone company for which she worked, an *x*-ray of the chest was taken and a sputum specimen was examined. The sputum was reported negative for tubercle bacilli and the *x*-ray, reproduced in Figure 1, showed atelectasis of the right lower lobe with possibly some chronic infection, and a similar involvement of the middle lobe. On August 10, 1939, another *x*-ray (Fig. 2) showed that there was only slight remaining increase in the lung markings at the right base and slight thickening of the interlobar septum. In November, 1939, an *x*-ray showed recurrence

of the atelectasis in the lower and middle lobes. In December, the patient developed another cold and was away from work for six days. There was a return of the right pleuritic pain with cough, which became productive for the first time. The sputum was still negative for tubercle bacilli.

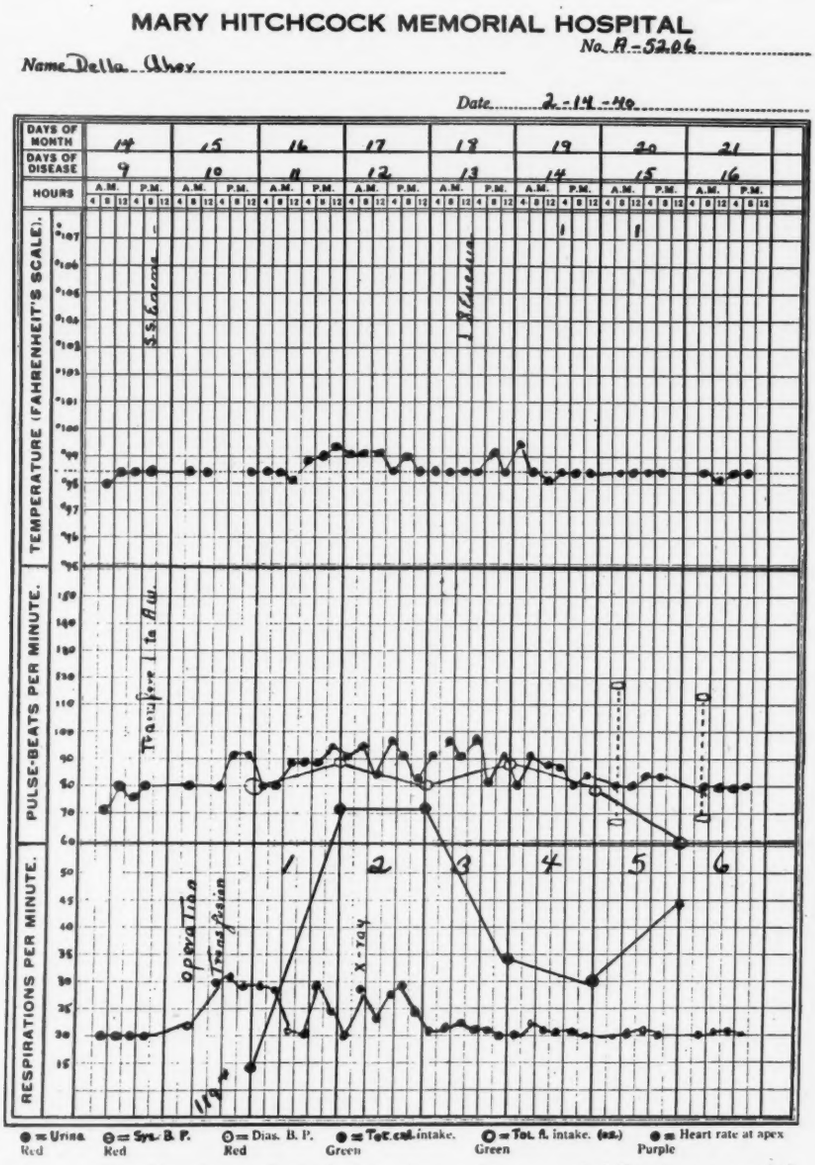

FIG. 4. Graphic chart of vital signs just prior to and following operation.

She was admitted to the hospital in January, 1940, at which time physical examination was entirely negative except for decreased aeration of the lower and middle lobes on the right. The usual laboratory examinations were negative. The red blood count was 4,790,000 with 14.4 Gm. of hemoglobin, and the white blood count was 5,200 with 61 polymorphonuclear cells, 9 of which were stab forms. A second strength tuberculin test was negative. Bronchoscopy was carried out by Dr. John A. Murtagh and a large, rounded tumor with a fairly broad base was found occupying the right stem bronchus and completely occluding the middle and lower lobe bronchi. It was thought that the upper lobe was well aerated. The tumor was firm and very vascular. Bronchoscopic biopsy was obtained and the tissue was diagnosed by Dr. Ralph Miller as benign bronchial adenoma though there was some question as to whether the tumor might not be very active. A suggestion of malignancy was held out by the pathologist, and another specimen requested.

Lipiodol examination at this time confirmed the impression of complete obstruction of the right middle and lower lobes. (Fig. 3.) It was assumed that there was bronchiectasis of the lobes or at least a "drowned lung" condition distal to the tumor.

Thoracotomy was decided upon as the safest method of treatment in this case. From the standpoint of contamination, it was thought safer to transect the bronchus without preliminary bronchoscopic removal of the tumor, since the obstruction was complete and there was no sputum. Preliminary pneumothorax was instituted and a complete collapse of the right lung was obtained for one week prior to operation.

Fig. 5.

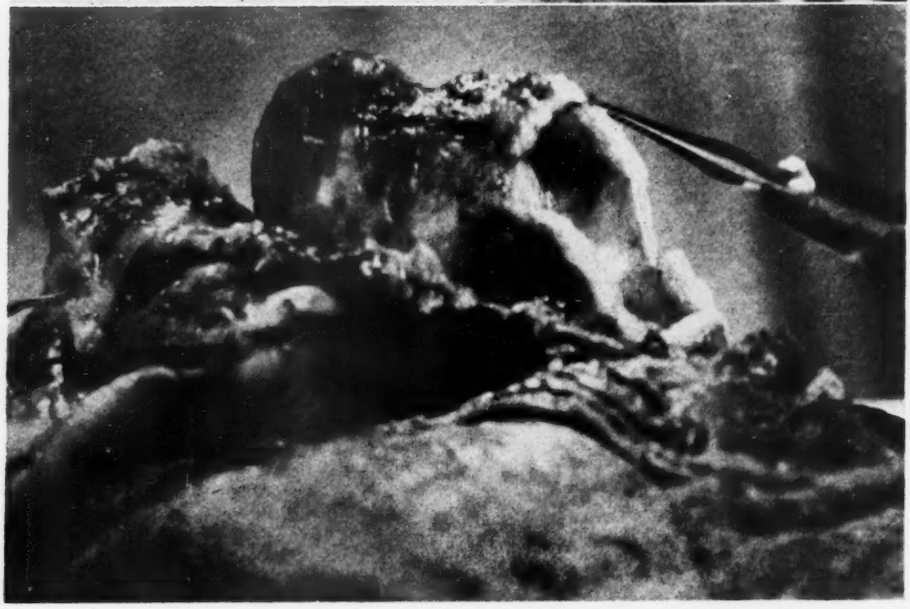

Fig. 6.

Fig. 5. The tumor is seen completely occluding stem bronchus to middle and lower lobes.
Fig. 6. Profile view of bronchus showing rounded edge of tumor in lumen and "hump" of tumor protruding through wall of bronchus.

On February 15, 1940, operation was performed. Under intratracheal anesthesia a right anterior incision was made extending from the angle of Louis downward and laterally in the mammary fold. The breast and pectoralis major were reflected upward and the fourth costal cartilage and anterior portion of the rib were removed. In opening the pleura it was found that the lung was completely atelectatic and there were only a few delicate, avascular adhesions present. In palpating the hilum the tumor mass could be felt protruding through the posterior surface of the main bronchus. It was seen that there was no anatomical separation between the upper and middle lobes. The lower and middle lobes were indurated throughout. A total pneumonectomy was decided upon because it was believed that if the tumor were to be completely removed, the incision in the bronchus would come so close to the upper lobe bronchus that closure of this structure would be inadequate or impossible. Also, if total pneumonectomy were not done, transection of infected lung tissue would have to be carried out, which would add to the risks involved. In addition, there was still no complete assurance of the benign character of the growth. Therefore, total pneumonectomy was carried out by incising the mediastinal pleura and securing the two main branches of the right pulmonary artery.

Fig. 7. Adenoma cut in two; upper lobe bronchus clear; mucopurulent material lying in middle and lower lobe bronchi.

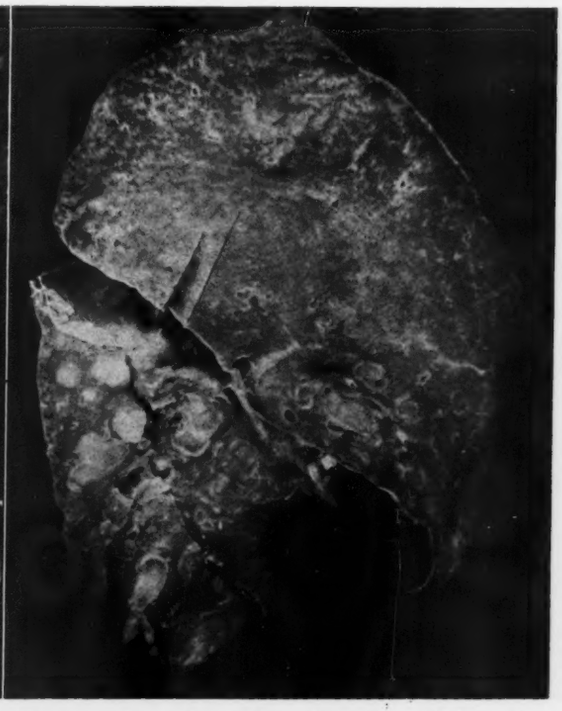

Fig. 8. Coronal section of lung; middle and lower lobes atelectatic; saccular dilatations of bronchi which are filled with mucopurulent exudate; no separation between upper and middle lobes.

The two pulmonary veins were similarly treated, ligation of all vessels being carried out within the mediastinum. The pulmonary ligament was then severed between clamps and the bronchus was dissected free. A ligature of braided silk was passed around the bronchus just distal to the tracheal bifurcation and tied snugly but not with crushing force. The bronchus was then divided just distal to the ligature and the end was sutured over with mattress sutures of No. 00 chromic catgut. The mediastinal pleura was then sutured over the end of the bronchus and the incision in the mediastinal pleura was closed with interrupted silk sutures. The hemithorax was irrigated with saline and the incision closed with silk. A transfusion was given though there had been but scant blood loss, and the patient was placed in an oxygen tent.

The chart of her postoperative course is depicted in Figure 4 and shows a very benign reaction to operation. The patient was not really sick at any time. Some fluid accumulated

in the right pleural cavity. This was aspirated one week after operation, cultured, and found to be sterile. On February 17th (two days postoperatively), her red blood count was 4,410,000 with 16.4 Gm. of hemoglobin. The patient was allowed up on the fourteenth postoperative day and was sent home on the twenty-first day. She was allowed to go back to her work as a telephone operator in a month and has been working practically uninterruptedly since.

Examination of the surgical specimen showed that the tumor was a benign adenoma. The adenoma had protruded through the posterior surface of the bronchus in a collar-button manner, the extrinsic portion being about a fourth as large as that portion within the lumen. The middle and lower lobes were completely obstructed and the bronchi of these lobes were filled with mucopurulent material. There were saccular dilatations of the smaller bronchi and these sacculations also were filled with mucopurulent material. The parenchymatous tissue of these lobes was completely atelectatic. Pictures showing the anatomical situation are reproduced in Figures 5, 6, 7, 8 and 9.

Microscopically the tumor shows the usual pleomorphic structure that has been so often described. (Fig. 10.) In some areas there

FIG. 9.

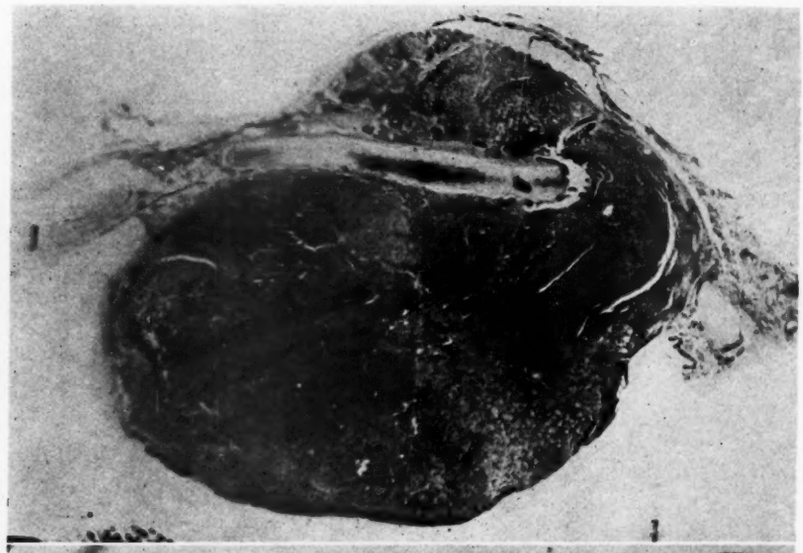

FIG. 10.

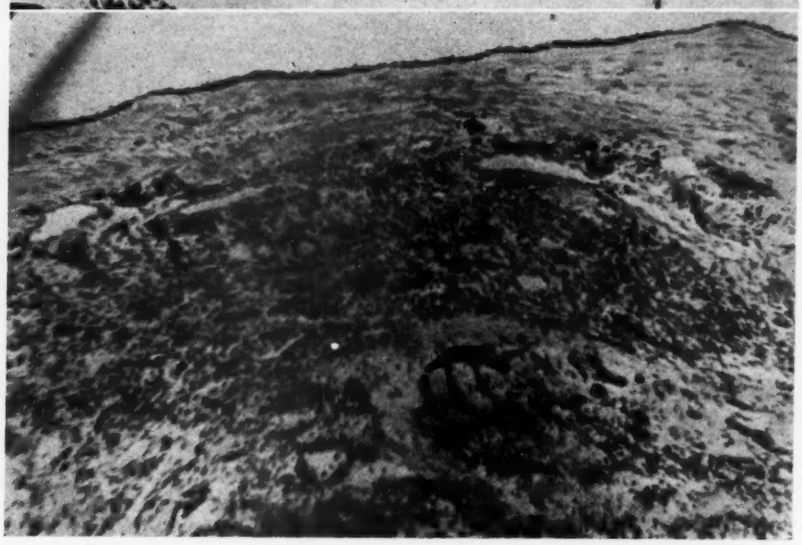

FIG. 9. The adenoma extends extrabronchially between two cartilage plates. The larger portion is endobronchial.

FIG. 10. Microscopic appearance of a typical area in the adenoma. The pleomorphic characteristics are shown.

is fairly definite acinar formation, while in others the epithelial elements are arranged in columns and occasionally in sheets. The supporting stroma is very vascular. There is no invasion of the basement membrane nor any invasion of adjacent tissue and the tumor is well encapsulated throughout. Examination of lymph nodes in the region of the bifurcation of the bronchi failed to demonstrate metastatic foci. A lymph node which had been removed from the mediastinum also failed to demonstrate any metastatic involvement by tumor tissue.

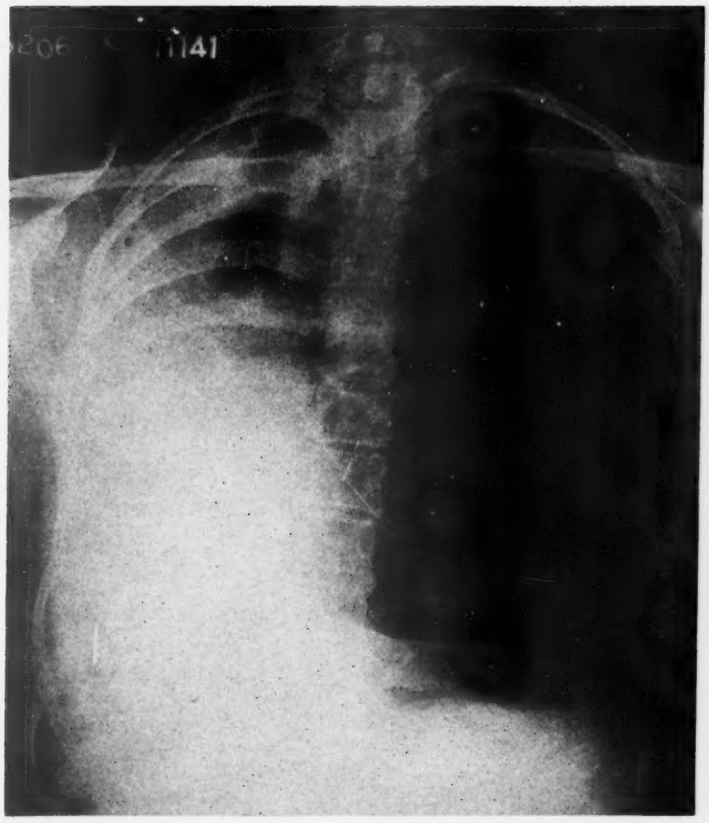

Fig. 11. Intrathoracic alterations sixteen months after pneumonectomy. There is angulation of the trachea with extreme shift of this structure to the right. The right diaphragm is elevated and the left lung has extended across the mid-line.

The patient has been followed faithfully in the clinic. Her vital capacity taken in the out-patient department in April, 1940, was 60 per cent of normal, and in September (seven months after operation) this had risen to 2,700 cc., which was considered 70 per cent of normal. An *x*-ray, taken on November 1, 1941, sixteen months after operation, is shown in Figure 11. This picture shows advanced changes in the thorax due to shifting of all structures to the right with great increase in size of the left lung. The trachea is sharply angulated to the right. The right thoracic cage is contracted and is occupied by the mediastinal structures and the left lung. The right diaphragm is elevated. If the patient walks briskly up a fairly steep grade she becomes a little breathless, and at such times she notices that her breathing is noisy, probably due to the angulation of the trachea. In February, 1942, the patient underwent an operation on her foot for hallux valgus. This operation was done under spinal anesthesia and was well tolerated. On January 11, 1943, three years postoperatively, the patient's vital capacity had risen to over 90 per cent and she stated that she could accomplish more than she could in the previous year. On the same visit the red blood count was 5,440,000 and the hemoglobin was 15.4 Gm. In April, 1944, the patient was delivered of a normal offspring at term. She had a completely normal convalescence from this event.

COMMENTS

Total pneumonectomy was performed in this case for several reasons. In the first place, there was no absolute assurance that the growth was benign and as soon as the chest was opened palpation revealed that the growth had extended through the bronchial wall posteriorly, which was considered a further indication for radical surgery. Also, the lesion was situated so near the primary division of the right main bronchus that it was doubted that closure of the upper lobe bronchus could be effected after sufficiently high section of the stem bronchus of the middle and lower lobes. Finally, the fact that there was complete anatomical fusion of the upper and middle lobes meant added technical difficulties in performing a partial operation, with the increased danger of empyema following transection of infected lung tissue.

The advisability of performing a thoracoplasty after pneumonectomy is still open to question. Certainly this individual's lung has been overdistended to practically twice its normal volume and in view of the work of investigators in this field such distention may not be an entirely desirable result because of the likelihood of the development of serious pulmonary emphysema due to loss of elastic tissue. Unfortunately, thoracoplasty cannot be carried out successfully after the appearance of symptoms of emphysema because it is a one-way reaction, and reducing the size of the thoracic cage at such a time would not be of benefit.

It has been over four years since the patient was operated upon and she is now thirty-one years of age. Her only subjective difficulty is that if she walks rapidly up a steep hill there is some shortness of breath and wheezing. There is no evidence of recurrence or metastasis. She is able to carry out her housework and her duties as a telephone operator without respiratory embarrassment. She had a normal delivery and puerperium in April, 1944. The future alone can tell whether the lung tissue in this case will eventually break down due to rupture of elastic tissue from overstrain. Against this possibility it is interesting to note that the patient's vital capacity and ability to carry out her ordinary activities have progressively improved in the four years following operation.

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REGIONAL JEJUNITIS*

REPORT OF AN UNUSUAL CASE†

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NON-SPECIFIC inflammatory conditions of the intestinal tract are not rare, but it is unusual to see these conditions in the upper gastrointestinal tract without a similar pathological condition in the terminal ileum. Likewise these inflammatory conditions seldom cause complete intestinal obstruction. The following report illustrates a case of segmental jejunitis causing complete intestinal obstruction:

CASE REPORT

K. W. (No. 521545), a thirty-two year old married negress, was admitted to the University Hospital complaining of abdominal distention and pain. For the past two or three years she had been troubled with "indigestion." This consisted of crampy mid-epigastric pain that usually appeared three to four hours after meals. Occasionally, the pain would be present during or soon after eating. The pain did not radiate but was aggravated by ingesting fatty foods. It was relieved by milk, soda, and stomach powders.

About five months prior to admission, and following a "fish supper," abdominal distention appeared. There was considerable associated borborygmus, and about twelve hours later she vomited the contents of the meal. Since then she had had several similar episodes of distention. For two weeks preceding her admission her abdomen was persistently distended; there were gaseous eructations, borborygmi, and a burning sensation in her pharynx. She had vomited only occasionally and then in small amounts. Bowel movements had been regular and without abnormalities. Ankle edema had been present for two weeks prior to admission.

The past history revealed an amenorrhea of three months' duration, and a spontaneous abortion nine months before admission. She had been married for fifteen years and had two children that were living and well. There was no history of tuberculosis or lues.

Physical examination revealed a chronically ill, emaciated young negress. There was obvious generalized edema which included the eyelids, cheeks and ankles. Her temperature was 99°F. orally, pulse 100 per minute, and respirations were 20 per minute. The significant physical findings were limited to the abdomen. It was greatly distended and there were loud borborygmic sounds. Numerous vigorous peristaltic waves were visible and on palpation several distended loops of bowel could be felt. There was a fluid wave and shifting dullness. By rocking the patient a succussion splash could be heard. Rectal and pelvic examinations were non-contributory. The heart and lungs were essentially normal and there was no lymphadenopathy.

Urinalysis was negative. The leukocyte count was 2,800 with 82 per cent polymorphonuclears and 14 per cent lymphocytes. The erythrocyte count was 3.97 million with a hemoglobin of 65 per cent Sahli. The carbon dioxide combining power of the blood was 68 volumes per cent; the non-protein nitrogen 31.4 mg. per cent; the serum chlorides 546 mg. per cent, and the serum protein 5.8 Gm. per cent.

Upon admission to the ward a scout film (flat plate) was taken of the abdomen. It revealed extreme distention of loops of small bowel set in an oblique pattern. (Fig. 1.) The transverse colon also contained gas, but was not particularly distended. On the basis of the history and *x*-ray findings a diagnosis of chronic small bowel obstruction was made. Due to the patient's poor general condition, and the

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† The case presented is of a patient treated in the University Hospital, University of Michigan, Ann Arbor, Michigan.

chronic character of her illness, it was decided to treat her conservatively, hoping that her general condition could be improved before surgery. A Miller-Abbott tube advanced as far as the proximal jejunum where it stopped. Despite the aspiration of large amounts of fluids and gas the distention was only partially relieved. All attempts to get the tube to progress further failed, even though there were distended loops of small bowel in the region of the tip of the tube.

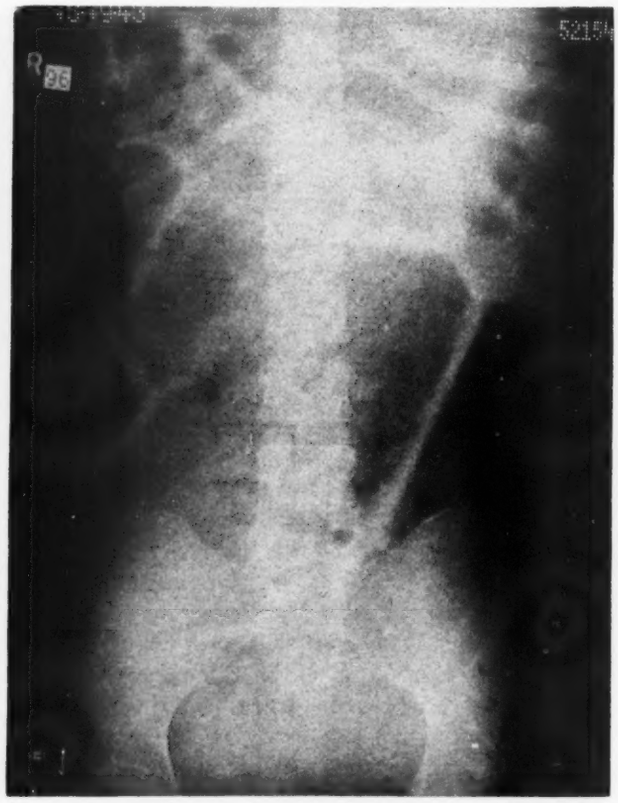

FIG. 1. Scout film showing extreme distention of small intestines. Some gas is also present in the colon and the stomach.

Under conservative therapy the patient showed little improvement and forty-eight hours after admission she was operated upon. The abdomen was opened through a right transverse incision which passed just below the umbilicus. The tissue of the abdominal wall was very edematous. Upon opening the peritoneal cavity a large amount of ascitic fluid escaped and greatly distended loops of small bowel presented themselves. Upon investigation it was found that the distended loops were jejunum. The distended jejunum was easily delivered into the incision. There was a moderate amount of fibrin about the edematous and dilated bowel. The obstruction appeared to be due to inflammatory strictures of the bowel wall. There were four such constrictions involving three segments of jejunum. (Fig. 2.) The uppermost constriction was only 20 cm. from the ligament of Treitz. The other three constrictions were scattered along the jejunum at varying distances for about four feet. Careful examination failed to reveal other lesions in the gastrointestinal tract. Approximately five feet of jejunum, including the four constrictions, were resected and an end-to-side anastomosis made between the distal and proximal segments of jejunum. The end of the distended (proximal) loop was anastomosed to the side of the collapsed (distal) loop. The incision was closed without drainage. During and immediately following the operation the patient received 500 cc. of blood and 500 cc. of plasma. The Miller-Abbott tube was replaced by a Levin tube, and constant Wangensteen suction applied. She was given oxygen per B.L.B. mask.

On the day following operation she was given another 500 cc. of plasma, and because of her complaints the mask was replaced by nasal oxygen. Her leukopenia persisted at about 3,000, so on the second postoperative day she was given pentnucleotide intramuscularly. By this time she was feeling much better. The nasal oxygen was discontinued on the morning of the third postoperative day and she was started on a liquid diet. By that evening she was slightly distended, so stomach suction was renewed and continued overnight. She was given another 1,000 cc. of plasma, following which she improved rapidly. Her leukopenia persisted despite pentnucleotide. Intramuscular liver was started in the hope that it might help correct her leukopenia and better her general condition. She developed a urinary tract infection which was treated by indwelling catheter with intermittent irrigation of boric acid solution. Sulfonamides were not given because of her leukopenia. She improved steadily, and by the eighteenth postoperative day her leukocyte count was 12,500, she was eating regularly, and was ready for discharge. She left the hospital three weeks after the operation. She returned six weeks later presenting a picture of health, having gained forty pounds in weight. At the present time, one year after operation, she has remained symptom free and has continued to gain weight.

The pathologists reported that the resected jejunum contained several chronic ulcers with vascular pyogenic granulation tissue. The base of the ulcers involved all the coats with scar tissue. There were marked sclerotic and obliterative changes in the arteries at the ulcer bases. Their diagnosis was chronic ulcerative enteritis closely related to, or the same as segmental ileocolitis.

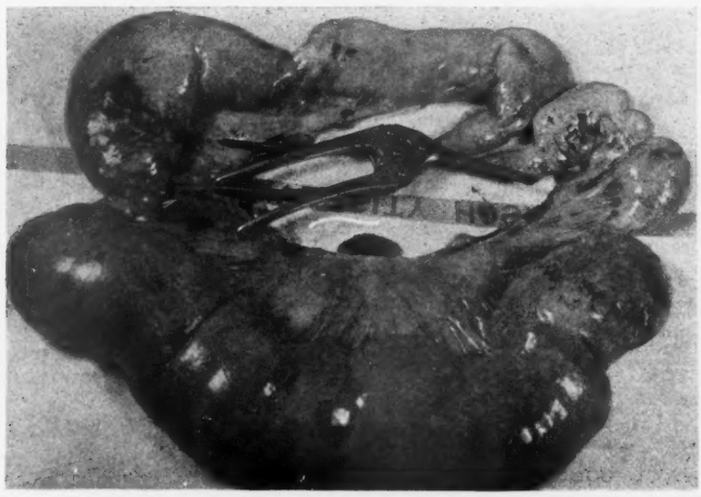

FIG. 2. Specimen as removed at operation. Note the several areas of constriction with dilated jejunum between. There is also extensive hyperplasia of the lymph nodes in the mesentery.

COMMENTS

As described by Crohn,[1] non-specific inflammations of the gastrointestinal tract occur most frequently in the region of the terminal ileum. Ginzburg and Garlock[2] have emphasized the fact that this disease distributes itself either regionally or diffusely throughout the gastrointestinal tract. When the diffuse type is encountered, the major pathological changes are usually located near the distal ileum. It is unusual to see the proximal jejunum involved without evidence of a similar process more distally. Pemberton and Brown[3] reporting on thirty-nine cases seen over a fifteen-year period list but three cases in which the jejunum alone was involved. Ginzburg and Garlock[2] report seeing twenty-two cases of jejuno-ileitis over a ten-year period, but they make no mention of any case in which the jejunum alone was involved. The third portion of the duodenum was involved in one of the

cases reported by Holloway,[4] but as so often happens, the terminal ileum was involved also.

Though this lesion is obstructive in nature it seldom causes as complete an intestinal obstruction as is illustrated by this case. Even in the more severe cases a narrow channel can usually be demonstrated by *x*-ray (string sign). The generalized nutritional edema present in this case undoubtedly contributed to the completeness of the obstruction. On examining the gross pathological specimen (Fig. 2) there were at least three areas of constriction, leaving isolated closed segments of small bowel that were greatly distended with fluid and gas. These isolated distended loops did not collapse until the constricting areas were incised. The segmental distribution of the ulcerated constricting areas with uninvolved intestine intervening is characteristic of the segmental type of this disease, and illustrates the so-called "skip areas."

Usually the jejunal variety of this disease is not amenable to surgery as the process extends over such a long segment that resection or side-tracking operations shorten the gastrointestinal tract too much. Due to the completeness of the obstruction in this case it was imperative that something be done. In view of the two isolated obstructed loops of small bowel, resection seemed to be the only rational form of therapy. Where the inflammatory process is limited to the terminal ileum, exclusion procedures are often done, but ultimate resection is usually indicated. In operating upon patients with this condition one must remember to divide the bowel well above the involved portion in order to avoid recurrences. Where a resection is performed, the mesentery need not be resected deeply, as the disease does not spread via the lymphatics as once thought. The fact that a year has passed since operation and there are no signs of recurrence makes the prognosis in this case quite hopeful. When recurrences appear, they usually manifest themselves within a year and practically always appear before two years.

SUMMARY

An unusual case of non-specific regional jejunitis is presented in which the proximal jejunum was completely obstructed at three isolated places. About five feet of jejunum was resected and an end-to-side anastomosis performed. The patient's recovery was uneventful, and she is well and symptom free one year later.

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CONGENITAL DIAPHRAGMATIC HERNIA*

VISCERAL STRANGULATION COMPLICATING DELIVERY

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WE wish to report a very unusual case of congenital diaphragmatic hernia complicating the puerperium. To the best of our knowledge, after careful survey of all similar cases which have been reported in the literature, our patient is the first one in which immediately postpartum surgical intervention has been attempted or successfully accomplished. We believe this case to be unique, because the diagnosis was made some few hours following labor, the hernia repaired, and the patient discharged in excellent condition on the thirteenth postoperative day, having made an uneventful recovery.

CASE REPORT

Mrs. L. P. entered the Obstetrical Service of the De Paul Hospital at 3:00 A.M. on May 19, 1943, in hard labor. The patient was a thirty-one year old white woman, gravida II. Her first pregnancy, labor, and puerperium were without incident. One hour and thirty minutes after admission, the patient spontaneously delivered a six pound two ounce normal female child. She was returned to her room in apparently good condition. Approximately five hours later, she began complaining of severe epigastric pain and was very restless. She became nauseated and vomited several times. Her respirations were labored and accelerated to 40 per minute. Her pulse at this time was 140. The patient became mildly cyanotic and appeared alarmingly ill. Dilaudid, gr. 1/32, was given for pain. Continuous gastric suction-siphonage was instituted. Oxygen per nasal tube was begun.

Physical examination of the chest revealed a splinted left thorax. The lower two-thirds of the left chest was dull to percussion, and no breath sounds were audible on this side. The cardiac sounds were best heard well within the midclavicular line. Cardiac dullness was questionably percussible to the right of the sternum. The right chest was resonant to percussion and the breath sounds were normal.

Examination of the abdomen revealed the usual postpartum contour, moderate distention, and generalized tenderness. A mass, which was thought to be an enlarged spleen, could be palpated in the left upper quadrant.

Roentgenograms of the chest and abdomen were taken in the patient's room. There was a marked increased density throughout the entire left lung field. The heart and mediastinal structures were shifted to the right. There was a distinct irregularity of the left diaphragm. The stomach, well outlined by entrapped air, was displaced into the left thorax. The tip of the indwelling nasal tube was disclosed to be in the stomach, which had migrated into the chest cavity. (Fig. 1.)

The patient's condition was becoming progressively worse; her pulse faster and weaker; her pain persisted; she was perspiring profusely; and her temperature was gradually rising. Strangulation of a viscus was feared and conservative treatment appeared no longer effective.

The preoperative diagnosis was left-sided diaphragmatic hernia with progressive strangulation of the hernial contents. (Fig. 2.) The required type of treatment was obviously surgical. Immediate exploration was advised.

Intratracheal cyclopropane anesthesia was used. A liter of normal saline solution plus 500 cc. of whole blood were given immediately by vein to combat shock.

A long left rectus incision was made from the xiphoid process to the left of the umbilicus. On opening the peritoneal cavity, considerable murky, free fluid was discovered and aspirated from both the abdominal and left thoracic cavities. There was a large congenital diaphragmatic hernia, through which all of the

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hollow viscera of the abdomen had migrated into the left thorax. The mesenteries of the stomach and intestines were elongated and

FIG. 1. Roentgenogram made with portable apparatus. This film was taken to include both thoracic and abdominal areas. Note the nasal tube extending into the left thoracic cavity. The arrows delineate a shadow of the walls of a hollow viscus, probably the stomach. There is no "gas pattern" whatsoever in the abdominal field. The upper portion of the left thoracic area was almost entirely opaque.

there had been a complete, counterclockwise rotation, causing torsion of the pancreas, which was acutely inflamed and covered by a fibrinoplastic exudate with numerous characteristic areas of superficial fat necrosis. The only organs remaining in the abdomen were: the spleen, which was enlarged to about twice its normal size; the liver, which was also enlarged and extended three or four finger-breadths below the costal margin; and the descending colon.

The viscera were easily replaced within the abdominal cavity. The gallbladder was blue and thin-walled. The appendix appeared to be normal. It was not disturbed. The recently postpartum uterus was well contracted in the pelvis.

The margins of the hernial opening were freshened with scissors and were approximated and overlapped about 1 cm., using interrupted sutures of No. 1 chromic catgut. A second row of interrupted heavy black silk sutures was inserted to reinforce the line of approximation.

The operative site and the incision were sprinkled with approximately 10 Gm. of sulfanilamide powder. The abdominal wall was then closed in anatomical layers without drainage.

The patient experienced a rather normal postoperative course. Constant gastric suction-siphonage was maintained for the first three postoperative days. Her fluid balance was maintained with parenteral glucose-saline solutions. Small, whole blood transfusions were

given to support her general condition. On the third day, her breasts became painfully engorged, for which stilbestrol, 5 mg. three times a day, was given for three days with complete relief.

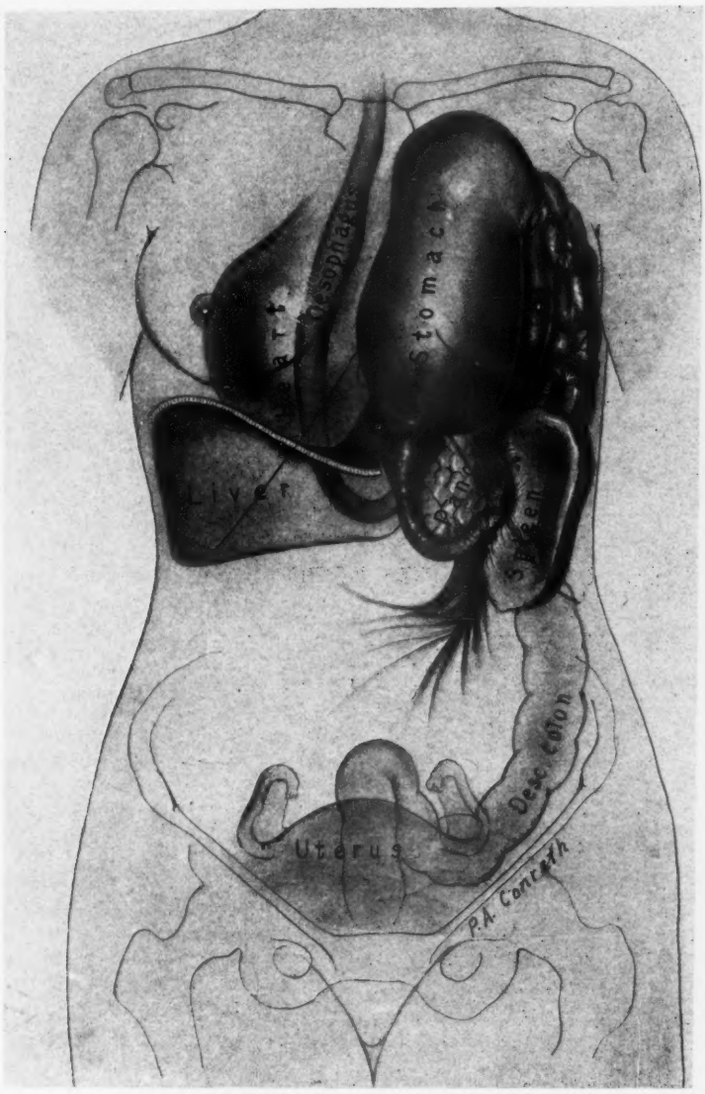

Fig. 2. A semi-diagrammatic representation of conditions discovered at operation. The liver, spleen, descending colon, and uterus were the only organs remaining in the abdominopelvic cavities.

On the eleventh postoperative day, roentgenograms of her chest were made. (Fig. 3.) Examination of these plates showed an almost complete collapse of the left lung with an extensive pneumothorax of the same side. There was a marked depression of the left diaphragm. No fluid level could be seen.

The patient was discharged on her thirteenth postoperative day in excellent condition. Her infant made normal progress.

This patient had evidently compensated for unusual intra-abdominal and intrathoracic pressure changes throughout her lifetime, and it seemed quite evident that her abdominal viscera had been making numerous and repeated excursions between both the abdominal and thoracic cavities without causing any symptoms of which the patient became aware. There was some question as to whether the left lung had ever been expanded completely to its normal capacity. For this reason, repeated examinations of the patient's chest were made. The breath sounds and percussion notes gradually became normal, and a chest plate made on August 3, 1943 (Fig. 4), demon-

strated that the left lung had completely expanded except at the costophrenic angle.

Roentgenologic examination of the thorax and gastrointestinal tract on this day revealed a low-lying, atonic stomach situated below the left leaf of the diaphragm, which moved normally, although its motion might possibly be considered slightly restricted.

The colon was markedly redundant and atonic. That the mesenteries were still abnormally elongated could be demonstrated by the ease with which these barium-filled viscera could be manipulated to distant corners of the abdominal cavity. (Fig. 5.)

COMMENT

Diaphragmatic hernia associated with pregnancy has been observed previously. It is possible for a patient harboring such an anomaly to undergo repeated labors without incident. In this patient, the unusual increase in intra-abdominal pressure caused by the contracting pregnant uterus prior to delivery, combined with straining of the abdominal muscles, unquestionably forced the abdominal viscera into the thoracic cavity with considerable violence. These forces, in addition to those of more or less excessive peristaltic contractures, could account for the counterclockwise torsion and rotation of the mesenteries. Such violent phenomena may not occur in every instance. The fact that this patient underwent her first pregnancy and delivery without incident would be confirmative. Therefore, it is probable that this condition remains undiscovered in many women simply because its presence is not suspected. A patient reported by Diddle and Tidrick[2] had undergone three uneventful deliveries yet succumbed shortly after the fourth. Autopsy was done on this patient and it is stated that the pancreas weighed 100 Gm. and contained large areas of hemorrhage, particularly toward the tail, with pancreatic necrosis. Undoubtedly, the cause of death in this patient was interference with the visceral blood supply produced by the strangulation at "the neck" of the hernial sac, which, in such instances, is formed by the opening in the diaphragm.

It would certainly not be considered good judgment to undertake as an elective procedure a formidable operation involving the organs of both the thorax and the abdomen in a woman who had just been delivered. However, the possibility of visceral strangulation was definitely considered in our patient, and emergency surgery was advised and undertaken as the only possible measure which would save the patient's life. It is our opinion that the use of intratracheal cyclopropane anesthesia, plus the usual supportive measures, contributed in no small way to the good result obtained. The most important factor, nevertheless, was the decision to operate immediately despite all hazards. Quite obviously, it would have been an advantage to have diagnosed the diaphragmatic hernia before pregnancy, so that its repair could have been undertaken under more ideal circumstances.

Since many women must harbor such congenital anomalies, the importance of careful clinical and roentgenologic studies of the thoracic organs of pregnant women would seem of paramount importance. Quite possibly, in early pregnancy, a repair of diaphragmatic hernia, either through the abdominal approach or by the transthoracic method, could be accomplished without unusual danger of miscarriage. In the later stages of pregnancy, the risk to both the life of the unborn infant and that of the mother would seem prohibitive. The grave danger of strangulation of abdominal viscera, followed by necrosis and subsequent death of the patient, is all too apparent.

Selection of the abdominal or transthoracic approach in the surgical treatment of strangulated diaphragmatic hernia in complicating pregnancy or delivery cannot be discussed on the basis of repeated experience. It would seem, however, that the abdominal approach in such cases is more preferable. There is probably less added shock to an extremely sick

patient. There might also be circulatory damage to the abdominal viscera requiring manipulations or possibly resection, which would certainly be somewhat more difficult if attempted transthoracically. Such contingencies, however, could admittedly take place only in those patients in whom a proper diagnosis was made at a relatively late period. It is also logical to assume that adhesions between the viscera of the entrapped abdominal contents and those of the thorax would produce symptoms which should lead to a diagnosis and surgical correction of such a congenital anomaly long before the child-bearing age. The choice of either surgical approach as an uncomplicated elective procedure is a matter of individual surgical experience and practice. The abdominal route was selected in our patient, because it seemed to be the quicker and easier of the two. The fortunately good result in this instance, at least, would vindicate our judgment.

Fig. 3. Roentgenogram of chest made on eleventh postoperative day, showing pneumothorax on left side. Arrows denote shadow of collapsed left lung and the restored contour of the left diaphragm, which occupies a position somewhat lower than the corresponding right diaphragm. The cardiac outline has a rather unusual gourd-like contour.

The scarcity of reports in medical writing of this rather unusual complication of pregnancy and the puerperium does not exclude the possibility that it might occur

more commonly than suspected. It is quite possible that death in the immediate hours following delivery might be caused by the unsuspected presence of this complication.

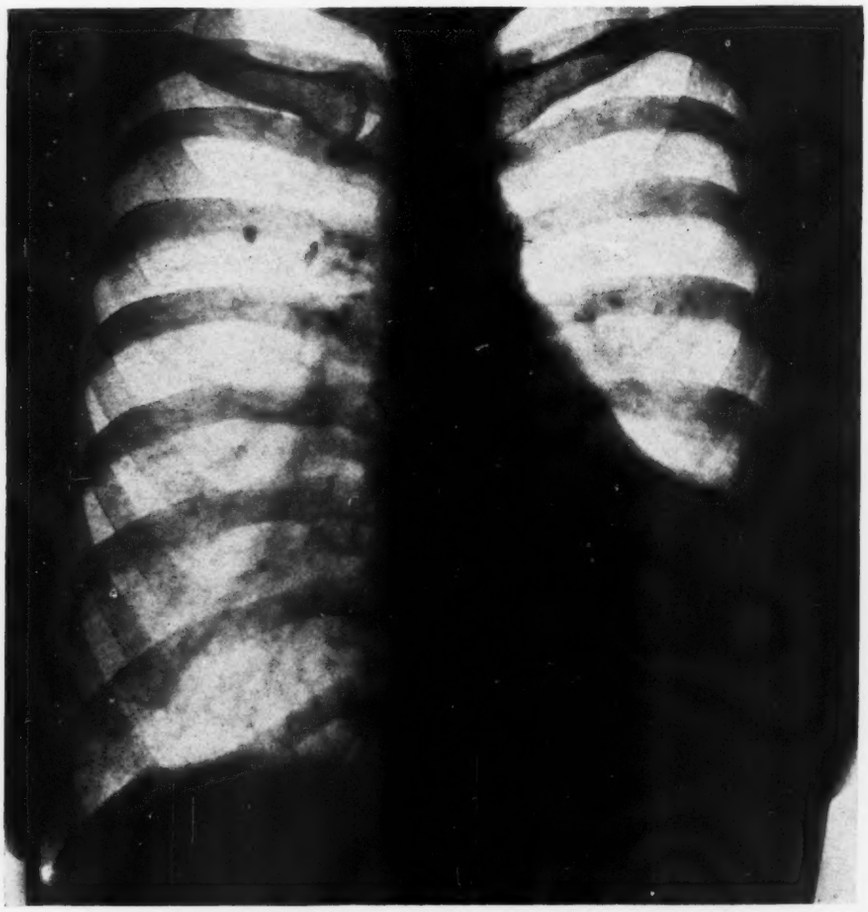

Fig. 4. Roentgenogram of the chest on August 3, 1943, demonstrating that the left lung has re-expanded. The cardiac outline occupies a relatively more normal position. There is still a compensatory over-expansion of the right lung, causing a shift of the mediastinum to the left. Breath sounds and other physical findings were normal.

The excellent results obtained in surgical repair in all types of diaphragmatic hernia, as reported by Harrington,[4] Truesdale,[6] and many others, would certainly justify recommending such procedures during the child-bearing period of life.

A case of diaphragmatic hernia complicating pregnancy reported by De Lee and Gilson,[1] responded to conservative treatment by gastric suction-siphonage, nasal oxygen, and sedation. It is our opinion, however, that if such measures are undertaken, they should not be persisted in for longer than a very few hours if the patient's response and improvement is not immediate.

Four fatal cases of diaphragmatic hernia diagnosed during pregnancy have been found in the literature. These are mentioned in the report of Diddle and Tidrick.[2] One of these patients was operated upon for appendicitis during the sixth month of pregnancy, but the appendix could not be located and the hernia was not found. The patient expired a few hours after operation, and at autopsy part of the large and small bowel were found incarcerated through the diaphragmatic defect. The other three patients had acute symptoms suggesting ileus at the fourth, eighth, and tenth lunar months, respec-

tively. Two of the three hernias were not diagnosed before necropsy, while the fourth was visualized on roentgenographic films.

FIG. 5. Roentgenogram of barium enema made on August 3, 1943, demonstrating a markedly redundant and atonic colon. The elongation of the mesenteries was evident, because of the ease with which the viscera could be moved throughout the abdominal cavity visualized by fluoroscope.

Two of these women (eight and ten months' pregnant) became ill with the onset of labor; one died the day after delivery, while the other lived only a few minutes after the third stage was completed. The last patient died in the fourth month as the result of acute strangulation of the hernia.

This brief summarization of four fatal cases serves to emphasize the importance of suspecting the presence of diaphragmatic hernias in women of child-bearing age, and the urgency of advising surgical repair.

SUMMARY AND CONCLUSIONS

Diaphragmatic hernia in pregnancy is not a common complication. The literature contains only a small number of reported cases. Four fatal cases diagnosed during pregnancy have been reported.

Two cases of diaphragmatic hernia complicating the immediate puerperium, treated by conservative measures without fatality, are all that the literature supplies.

The case report herewith submitted is, to the best of our knowledge, the first one in which the patient has been operated upon with a successful result. The surprisingly uneventful recovery of the patient would seem to recommend surgical treatment of this complication immediately upon diagnosing strangulation, since a time-honored principle in the treatment of all types of strangulated hernias is immediate emergency surgical intervention.

This complication will arise again. Its diagnosis is not difficult. Conservative treatment should, of course, be attempted. Constant observation, tempered with the thought of the possibility of strangulation of the hernial contents, should be the ever present consideration of the attending obstetrician.

Surgical repair of large, congenital or acquired diaphragmatic hernias during early pregnancy would seem justifiable because of the very grave danger of strangulation during the later months of gestation or as a complication of delivery or the puerperium.

We are greatly indebted to Dr. H. A. Klein and to Dr. D. B. Flavan for the opportunity of seeing this patient in consultation. It was they who made an early and correct diagnosis and urged us to undertake the surgical procedure, which was fortunately successful.

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NEUROFIBROMA OF THE CAROTID BODY

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NUMEROUS cases of tumor of the carotid body have appeared in the literature and several recent comprehensive reviews of this subject have been made. The majority of these tumors are characteristic arising in the epithelial type of cell. A few tumors of nerve cell origin have been recorded and these are definitely in the minority. The purpose of this paper is to present another case of carotid body tumor showing a neurofibromatous character with no evidence of epithelial tissue in the tumor. Clinically, the tumor showed symptoms and signs similar to those in the usual carotid body tumor. The tumor proved to be a neurofibroma arising apparently from the glossopharyngeal nerve. Neurofibromas of the cranial nerve other than the acoustic nerve are uncommon and the symptomology of such tumors depends upon the location and nerve involved. The pathological picture, however, is characteristic of neurofibroma in the following case. Although these tumors are frequently multiple, the case presented shows no evidence of other similar tumors.

FIG. 1. Neurofibroma of carotid body.

CASE REPORT

Mrs. R. M. age thirty-eight, was admitted to Huron Road Hospital September 12, 1943. She complained of a mass in the right side of the neck of approximately six years' duration. The mass had been enlarging for the past two years and had become conspicuous. The patient wished to have the mass removed mainly for cosmetic reasons. The family history of the patient was essentially negative except for the fact that her father died of carcinoma of the liver. The past history of the patient showed nothing of importance. Examination showed a well nourished, alert, young female with no apparent abnormalities except a swelling on the right side of the neck. Here, there was a large, round, firm mass extending from a point just below the lobe of the ear, midway into the neck along the sternocleidomastoid muscle. The mass could be moved horizontally; verticle motion, however, was limited. Examination of the heart showed it to be of average size, with normal

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force, rate and rhythm. The pulse was of good volume. The blood pressure was 130 systolic, 85 diastolic.

The patient was taken to surgery on September 14th for removal of the tumor. The incision was made in the right side of the neck just below and parallel to the angle of the jaw over the tumor mass through the skin, subcutaneous tissue and platysma. The incision was carried down until the capsule of the tumor was found and examination of the mass showed it to be within the carotid sheath, covering the external and internal carotid arteries. The jugular vein and vagus nerve coursed over the top of the tumor. By sharp and blunt dissection the tumor was removed without injury to the remaining contents. After removal of the tumor the sheath was closed. The muscle fibers were brought together with plain catgut, the platysma was brought together with plain catgut, and the skin was closed with clips. A sterile dressing was applied and the patient was returned to bed in good condition.

The immediate postoperative course appeared satisfactory with the exception of a slight occasional irregularity of the pulse. The blood pressure fluctuated between 150 and 100 systolic and after twenty-four hours leveled off to 130 systolic and 80 diastolic. The morning following the operation, the patient complained of numbness of the right side of head, tongue, lips and cheek. This sensation and numbness disappeared within the next twenty-four hours, except for the numbness of the right side of the tongue. The patient was discharged on September 21, 1943, in a definitely improved state.

Five weeks postoperatively, the patient presented no clinical abnormalities and the feeling of numbness of the tongue was gradually disappearing.

The pathological examination revealed the following: Specimen consists of a tumor mass measuring 7 cm. in length 4 cm. in diameter, partially covered by a thick, opaque, fibrous capsule. On section, the tumor shows a nodular structure with one large nodule present measuring 2½ cm. in diameter, showing the tissue fleshy, yellowish gray with small hemorrhagic areas present. In other areas the tumor is hard, coarse, gray with a fibrous architecture. There are present several small lymph nodes, the largest 7 mm. in diameter. On section, the tissue is fleshy, yellowish gray.

Microscopic Examination: Section one shows portion of a tumor with a thick covering of fibrous tissue with scarring and infiltration by round cells here. In the deeper portion, the tumor shows large masses of spindle cells, with definite palisading of the nuclei and there is considerable loose fibrillar stroma present. In other areas, there are large cells suggesting ganglion cells also lying in a fibrillar stroma. A few nests of large clear staining cells are also seen. Section two shows a similar picture with considerable old and recent hemorrhage, considerable scarring and infiltration by round cells and some pus cells. Final diagnosis: neurofibroma.

The carotid body is classified as one of the chromaffin glands and has as its main constituent large polyhedral cells resembling epithelium. The cells are arranged in alveolar formation with no ducts or gland lumina present. They have a rich capillary and nerve supply. Anatomically, they are closely related to the carotid sinus and receive their nerve supply from this structure. The actual function of this gland is not known and its tumors have no apparent endocrine significance. Tumor formation is the only important disorder of this body and numerous such tumors have been described. The majority of these tumors arise from the large polyhedral epithelium-like cells which are arranged in alveolar or syncytial masses. In some cases the connective tissue or vascular stroma may predominate. This type of tumor suggests origin in paraganglionic tissue. A few cases in the literature show predominence of neurofibromatous elements with elongated cells arranged in bundle-like units and showing palisading of the nuclei. This type of tumor arising in the carotid body is very unusual. The case reported is of this type with predominence of neurofibromatous tumor tissue, although a few ganglionic cells were seen.

SUMMARY

A case of an unusual neurofibromatous type of carotid body tumor is presented.

The clinical features were similar to those of the ordinary epithelium-like cell tumor of the carotid body.

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Hyperthyroidism results from an excessive absorption of the thyroid secretion (*thyroxin*) and is characterized by the stimulation of nearly every bodily function. A toxic goiter is one characterized by hyperthyroidism, or in the case of a diffuse toxic goiter with exophthalmos, possibly a toxic dysthyroidism.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

PERFORATED ULCER OF ESOPHAGUS FOLLOWING A BURN

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IN 1842, Curling first described as a clinical entity an ulcer of the duodenum following a burn. Ten years before Dupuytren, according to Maes, had mentioned an ulceration of the intestine in patients who survived the immediate effects of a severe burn. Although it has been one hundred years since Curling brought out the relationship between a burn and an ulcer of the duodenum, the etiology of the ulcer is still unsolved. Curling's theory as to the etiology of these ulcers is rather interesting and ingenious when one considers the limited medical knowledge of 1842. He believed that the enlarged and infiltrated glands of Brunner was an act on the part of the glands to compensate for the suppressed dermal exhalation, brought about by the sudden arrest of the important functions of the skin. The hyperactivity and irritation of the glands leads to inflammation, ulceration and sometimes perforation. This more or less explained the specific localization of the ulcer. He also believed that this theory was proved by the fact that the ulcer, if not fatal, goes on to recovery when the functions of the skin have been re-established. The trouble with Curling was that he failed to consider those cases in which the ulcer did not develop until the burned areas of the skin were healed or were progressing satisfactorily toward recovery.

Since Curling's time there have been more than thirty different theories as to the cause of the ulcer, nearly as many theories as observers. The most popular among this large group are: (1) Action of the burn toxin; (2) stasis due to blood concentration; (3) stasis due to low blood volume; (4) adrenal theory; (5) embolic theory; (6) septic theory; (7) hypothalamus theory; (8) autonomic theory, and (9) nutritional disturbance. Of all the theories advanced, not one has been satisfactory and the process that takes place is still unsolved.

Maes states that "the concensus of modern opinion regards the toxemia of burns rather than the circulatory disturbance, as responsible for the production of the associated duodenal ulcers." Such ulcers are more frequently found in children than adults and, since toxemia is more marked in children, may help to explain and prove the toxemia theory. The ulceration, as Curling described it, is of an acute character and has been known to occur within eighteen hours after the injury. Maes states that "Curling's ulcer is very largely an unknown lesion. If it is mentioned at all in the textbooks, the description is of a very cursory character. This is partly due to the fact that it is seldom recognized during life, partly because its incidence is variable and rather low, and chiefly because it is most frequent in children whose symptoms are notoriously vague and in whom it is easy to overlook the diagnosis of even more unusual conditions."

Although it has been over one hundred years since Curling established the sequence of burns and duodenal ulcers, there is still no uniformity of opinion as to the incidence of the lesion. Maes stated that Erickson found them in two of twenty-eight fatal cases, that Ronchesi found them in one of 348 cases, and that Fenwick stated that they are present in 6.2 per cent of all deaths from burns.

Harris, with an experience of 567 cases and 138 deaths over a twelve-year period, found only one case. Levin found only two cases in 12,000 autopsies. Friedenwald, Feldman and Zinn stated that "a few instances of peptic ulcer of the esophagus have been described in children. Spiegelberg and Merir observed fatal hemorrhages in two infants, aged five and six years, and Dorn reports a similar outcome in a female, aged five months, due to an ulcer situated just above the cardia."

Fig. 1. Lower end of esophagus and stomach showing perforation of ulcer of esophagus.

According to Stewart, chronic peptic ulcer of the esophagus was found in one out of 10,000 autopsies and Chevalier Jackson, in 1929, using the esophagoscope, found twenty-one active ulcers and sixty-seven scars in 4,000 cases.

A search of the literature revealed only one case of a perforation of the esophagus following a burn. This was a woman with perforation of the esophagus on the fourth day after admission and who had been admitted because of severe burns of the back and buttocks and which resulted in death. This was reported by Robinson in the *British Medical Journal* of April 3, 1943. The following case, therefore, is of interest not only because of the nature and type of case, but because of the extreme rarity of the condition. I am, indeed, aware of the pitfalls of reporting single cases, but I think I am justified under the circumstances.

CASE REPORT

A boy, aged four, was admitted to the surgical service at Delaware County Hospital on October 12, 1940, suffering with second degree burns of both thighs, buttocks and lower abdomen. Two days before, while playing with his brother, he sat down accidentally into

a basin of hot water. He was taken to the accident ward of the hospital, where he was seen by the chief resident physician and the burns were treated with tannic acid jelly. Since there was no bed available, he was not admitted but was sent home with instructions to the parents to consult their family physician the next day and bring the child to the surgical clinic on Saturday morning, two days later. These plans were followed and the mother brought the child to the surgical clinic on Saturday morning, October 12, 1940, and, since there was a bed available, the child was admitted to the surgical ward around 11:30 A.M. On admission the child was not acutely ill. There was a slight elevation of temperature (100°F.) and the burned areas were in very good condition. The prognosis seemed very good. About the middle of the afternoon, the child cried out as if suffering from a sudden acute pain and it was necessary to give codeine by hypo to control some of the pain. The general condition of the child gradually grew worse in spite of everything we could do and died around 5:20 P.M. Autopsy by Dr. A. D. Waltz revealed a perforated "Curling's" ulcer of the esophagus with hemorrhage.

SUMMARY

1. Ulcer of the esophagus following burns is extremely rare.

2. Perforated ulcer of the esophagus following burns is even more rare than an acute ulcer.

3. A case of perforated ulcer of the esophagus with hemorrhage occurring in a child and causing death is hereby reported.

4. Although none have been treated surgically, the only hope for the patient lies in immediate operation.

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BRONCHOCOLIC FISTULA

RUSSELL BUXTON, M.D. AND RACHELLE L. KURMAN, M.D.
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NEWPORT NEWS, VIRGINIA

A SEARCH of the literature for bronchocolic fistula revealed but one case which occurred in Vienna in 1936, although about sixty cases of bronchobiliary fistula were found. Poverty of such material in the literature merits the reporting of the following case of bronchocolic fistula.

CASE REPORT

This nine year old, colored, male child was admitted to the hospital May 14, as an emergency case complaining of severe abdominal pain with nausea, vomiting and a temperature of 102°F., pulse 120 and respirations 20. The family history and past history were negative. The patient had experienced lower abdominal pain for three days before admission and on the night before, the pain had become quite severe in the right lower quadrant with much tenderness. It is of note that the patient had taken a dose of castor oil with resulting purgation. Physical examination revealed a well developed, apparently well nourished child in acute pain and temperature 105°F. Respiratory and cardiovascular systems were normal. Examination of the abdomen revealed rigidity on the right side with pain and tenderness over McBurney's point. No further physical abnormalities were seen. Laboratory examination on the day of admission showed a trace of albumin in the urine with rare hyaline and granular casts; specific gravity 1.006; the blood picture showed a red blood count of 4,660,000 and hemoglobin 93 per cent. A white blood count showed 16,800 with 89 per cent polymorphonuclears, 7 per cent lymphocytes and 4 per cent monocytes. A diagnosis of gangrenous appendicitis with perforation was made and the patient was immediately taken to surgery.

Operation proved the diagnosis to be correct. The appendix was found gangrenous, perforated and retrocecal in position. When tension was made upon its removal, it ruptured at the base in such a manner that it could not be removed in its entirety. No bleeding was encountered and sulfanilamide powder, 8 Gm., was placed into the iliac fossa and wound. The peritoneum was closed loosely after one Penrose and one cigarette drain had been inserted. Subsequent pathological examination reported an appendix 4 cm. in length with serosa granular and covered by fibrinous exudate. On section, the wall was discolored. Microscopically, it showed the wall to be infiltrated throughout by pus cells and the mucosa partially destroyed.

The patient was placed on sulfanilamide therapy and intravenous infusions. On the second postoperative day a laboratory report still showed traces of albumin in the urine with many hyaline casts this time, the specific gravity still 1.006. The blood showed a marked secondary anemia of 2,540,000 red blood cells with hemoglobin of 48 per cent, white blood count up to 17,400 (though this may be relative) with 83 per cent polymorphonuclear leukocytes, 15 per cent lymphocytes and 2 per cent monocytes. Blood sulfanilamide was 5 mg. A blood transfusion was given. The temperature remained elevated up to and around 104°F. Ten days after operation, the anemia was still seen with red blood count of 2,620,000, hemoglobin 28 per cent, white blood count, however, was down to 7,750 with a normal differential. Urine was negative; the temperature had dropped to around 101°F. Sulfanilamide was stopped the next day because of the anemia. A transfusion was given. In the next two weeks the patient's temperature continued a septic course with 101°F. as a base line and a rise every evening. Drainage persisted and the patient was placed on sulfathiazole. No response was seen, however, and it was discontinued after five days. On June 11, 1941, the twenty-eighth postoperative day, after the temperature had seemingly subsided, it again rocketed up in four hours to 105.4°F. with the patient coughing, spitting and vomiting up a bloody purulent material. It was

feared that an intra-abdominal abscess had ruptured into the duodenum but physical examination and *x*-ray showed consolidation of a bronchus in the right lung. From this the diagnosis of bronchocolic fistula was made. The patient was discharged on July 18th,

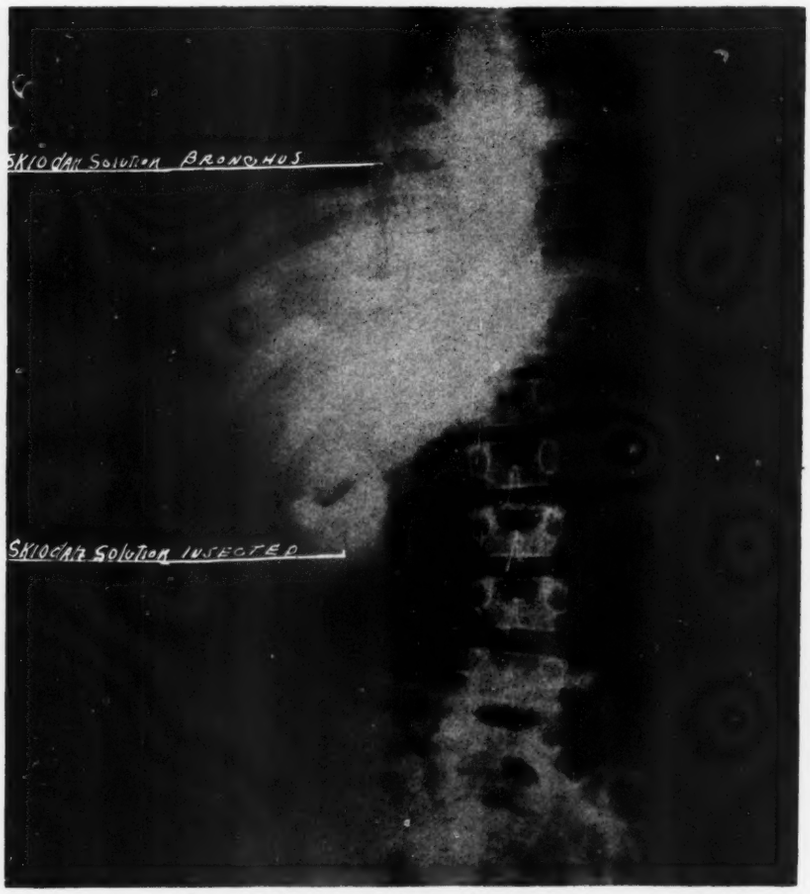

FIG. 1. Skiodan solution was injected into the abdominal fistula.

right lung. Sputum examination showed 4+ pus cells, numerous bacteria of all varieties, streptococci predominating and rare pneumococci. With use of postural drainage, some improvement in the patient's condition was noted but the temperature stayed up ranging from 99° to 103°F. During this period the appendiceal incision continued to drain profusely, the base of the right lung remained flat to percussion and râles were heard. On July 13, the sixtieth postoperative day, one ounce of 1 per cent mercurochrome was injected into the draining abdominal sinus and for twenty minutes the patient spit up mercurochrome tinged sputum. A fistulous tract connecting the right lower quadrant opening with lung seemed probable. On July 15th, skiodan was injected into the appendiceal fistula. An *x*-ray revealed a sinus tract which could be traced upward behind the liver and extending through the diaphragm delineating improved, temperature 100.2°F. and advised to be treated conservatively at home. On April 4, 1942, the boy came to the office at which time his temperature was 98.2°F. There was still some cough present but no expectoration. Some ronchi at the right base were heard. The abdominal scar was well healed.

In contrasting this case with the other previously reported, it is of interest to note that the Vienna case started with a left pneumonia, complicated by empyema which burrowed downward into the colon, while in this instance, the suppurative process started in the appendix and burrowed its way upward into the chest.

SUMMARY

This case is of a nine year old colored child. On admisson the diagnosis of

gangrenous appendix with perforation was made. He was operated upon immediately. His postoperative course was one of infection with elevation of temperature and severe secondary anemia. On the twenty-eighth postoperative day the patient developed a temperature of 105°F. with coughing, vomiting and spitting a purulent, bloody material. *X*-ray examination revealed consolidation of the base of right lung. Skiodan was injected into the appendiceal fistula and *x*-ray revealed a sinus extending through the diaphragm into the bronchus. The patient was discharged with the bronchocolic fistula still draining. Nine months later the patient had apparently recovered except for a slight cough. Two years later the child is reported to be completely normal.

Felkl, H. and Michalek, E. Bronchocolic fistula in a boy, 5¾ years old. *Wien. klin. Wchnschr.*, 49: 875–877, 1936.

The most common *indication* for lobectomy is bronchiectasis. Other indications are benign and certain types of malignant tumors, lung abscess, and tuberculosis.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

New Instruments

AN IMPROVED THYROID FLAP RETRACTOR

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THE retractor herewith described was devised by the author about two years ago in an attempt to obtain constant adequate and flexible mechanical retraction of the superior skin flap in the customary collar incision employed for thyroidectomy. Available retractors were found to be unsatisfactory for a number of reasons, the chief one being that they were inflexible and further limited an already restricted operative field. The common practice of retraction by means of an Allis clamp held by an assistant presented the disadvantage of keeping one of his hands occupied,—thus decreasing his efficiency. Employment of a second assistant for the sole purpose of retraction was not satisfactory since it put an additional pair of hands in the already limited operative field. Another alternative of retraction by means of an Allis clamp held by a second one attached to the anesthetist's screen was likewise not satisfactory since it did not give adequate retraction, was not flexible, and presented the undesirable feature of occasionally producing necrosis in the flap at the site of application.

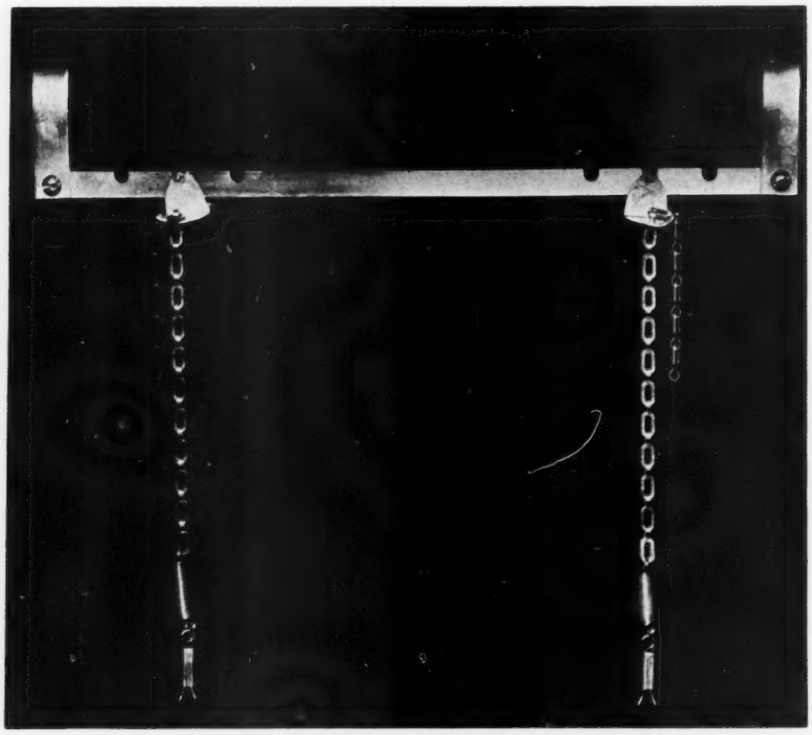

FIG. 1. Complete retractor showing parts.

Bearing in mind that only too frequently devices are offered which are subsequently found to be of value in the hands of the author alone, we, therefore, purposely delayed publication in order that ours

might have an adequate opportunity to demonstrate its usefulness in the hands of other members of our staff whose critical comment we sought. It has been employed in well over one hundred thyroid operations, and we are presenting the instrument as a means of retraction superior to any other hitherto advanced.

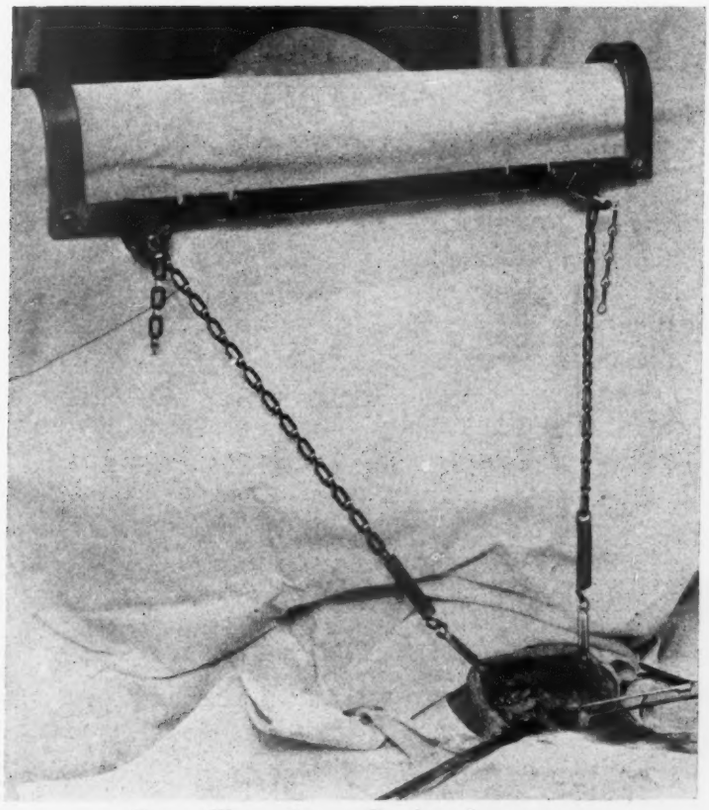

Fig. 2. Illustrating application of retractor.

The retractor consists of three parts (Fig. 1): A notched metal bar 14 inches long by ½ inch wide by ⅛ inch thick. This bar has two sliding clips mounted on it, and to each end of the bar are fastened two "U" shaped bars which permit hooking the device over the frame of the anesthetist's screen. Two pieces of light chain to each of which is attached a light coiled spring (having a pull of one to two pounds); to each spring, a light double hook is attached. In our retractor, these hooks were fashioned out of ordinary safety pins.

The use of screws or other parts easily lost was carefully avoided. It is readily sterilized and permits a wide range of flexibility of retraction such as may be indicated when working on either the right or left lobe by simply shifting the clamps in the notches provided. Its application is amply illustrated by the accompanying photograph. (Fig. 2.) The cost of construction is negligible since it can be readily made up of material usually available in the maintenance department of the hospital. We found it necessary to employ a heavier anesthetist's frame than is usually found on the average operating table. Ours was made of strap iron one inch wide and ¼ inch thick, salvaged from a discarded piece of metal furniture. This heavier frame is held in the clamps usually used for the Trendelenburg's shoulder rests.

The advantages claimed for this retractor are that it gives adequate flexible mechanical traction with a minimum of trauma, does not interfere with the operative field, is simple in construction, and can be easily duplicated at low cost from readily available materials.

RESUSCITATOR INCUBATOR

LIEUT. COL. HARRY M. KIRSCHBAUM
MEDICAL CORPS, ARMY OF THE UNITED STATES

DURING the past two decades there have been a number of additions and improvements in equipment for resuscitation and immediate management of the newborn infant. Most of our modern obstetrical pavilions are provided with the latest of such equipment. It has been the experience of the author to find, however, that this equipment is usually scattered throughout the delivery room and requires handling by several persons. The war emergency has limited the availability of interns, nurses and other trained personnel. This limitation affects the delivery room as well as every other department of the modern hospital, often making it necessary for the obstetrician personally to manage the newborn infant during the time he is concerned with the mother. For this reason the author set out to devise an apparatus which would concentrate all the equipment necessary for resuscitation and immediate management of the newborn and which would be so constructed as to enable the obstetrician, with little or no help, to use it without a break in sterility. After a considerable amount of experimentation and research such an apparatus was devised and is hereby described. Since it can be used as both a resuscitator and an incubator it is called the "resuscitator-incubator."

The resuscitator-incubator is a cabinet which contains a suction and pressure pump, an oxygen tank, a heating element, several drawers, tubing, electrical wiring and switches. The cabinet top is adapted as a table to convert into an incubator. The entire unit is about as large as a nursery cabinet and can occupy the space in the delivery room which is now usually set aside for the Mayo table. Figures 1 and 2 diagrammatically picture the apparatus.

The apparatus can best be presented by detailing its possible uses during a theoretical delivery: As soon as the baby's head is born the mucus can be removed from its mouth by attaching the sterile adaptor T3 to the suction outlet 4. The suction machine is controlled by the foot switch 2'. When the baby is delivered it is placed on the table which consists of a galvanized screen overlying a heating unit, thermostatically controlled. The screen is, of course, covered by a sterile blanket and sheet. If the baby now needs resuscitation, direct oxygen can be given by attaching the sterile adaptor T3 to oxygen outlet M and connecting to the adaptor an oxygen mask. The oxygen is delivered from the tank F and measured by a visible meter F1. The pump is controlled by an electric switch marked 2.

If it is found that the baby does not respond well, intratracheal suction can be provided as follows: Pressure on lever P1 exposes a drawer by spring action which contains a sterile tracheal catheter and a sterile syringe, needles and medication. The catheter is attached to the sterile adaptor T3 which in turn is attached to the suction outlet 15 and the suction machine controlled by electric switch 2'. When the catheter has removed the tracheal mucus it may be left *in situ* to deliver oxygen rhythmically thirty times a minute at a pressure of 13 mm. of mercury. This is done by transferring the adaptor T3 from suction outlet 15 to oxygen outlet M1 and pressing switch R. Medication can be provided at this point or at any time by using the syringe and material contained in the drawer described above. This drawer

springs back into place when the lever (foot pedal) P1 is depressed.

The apparatus can now be converted to an incubator by placing the hood, which is constructed of glass in a wooden frame, over the table top. The heat provided by resistant coils in the heat unit B is automatically controlled by the thermostat S1.

Humidity is controlled by a humidistat constructed in the hood. Oxygen is delivered to the incubator through tube z which is controlled by a switch accessible from the outside of the cabinet.

The cabinet also contains several drawers on the side of the unit for storage of sterile instruments and materials which may be

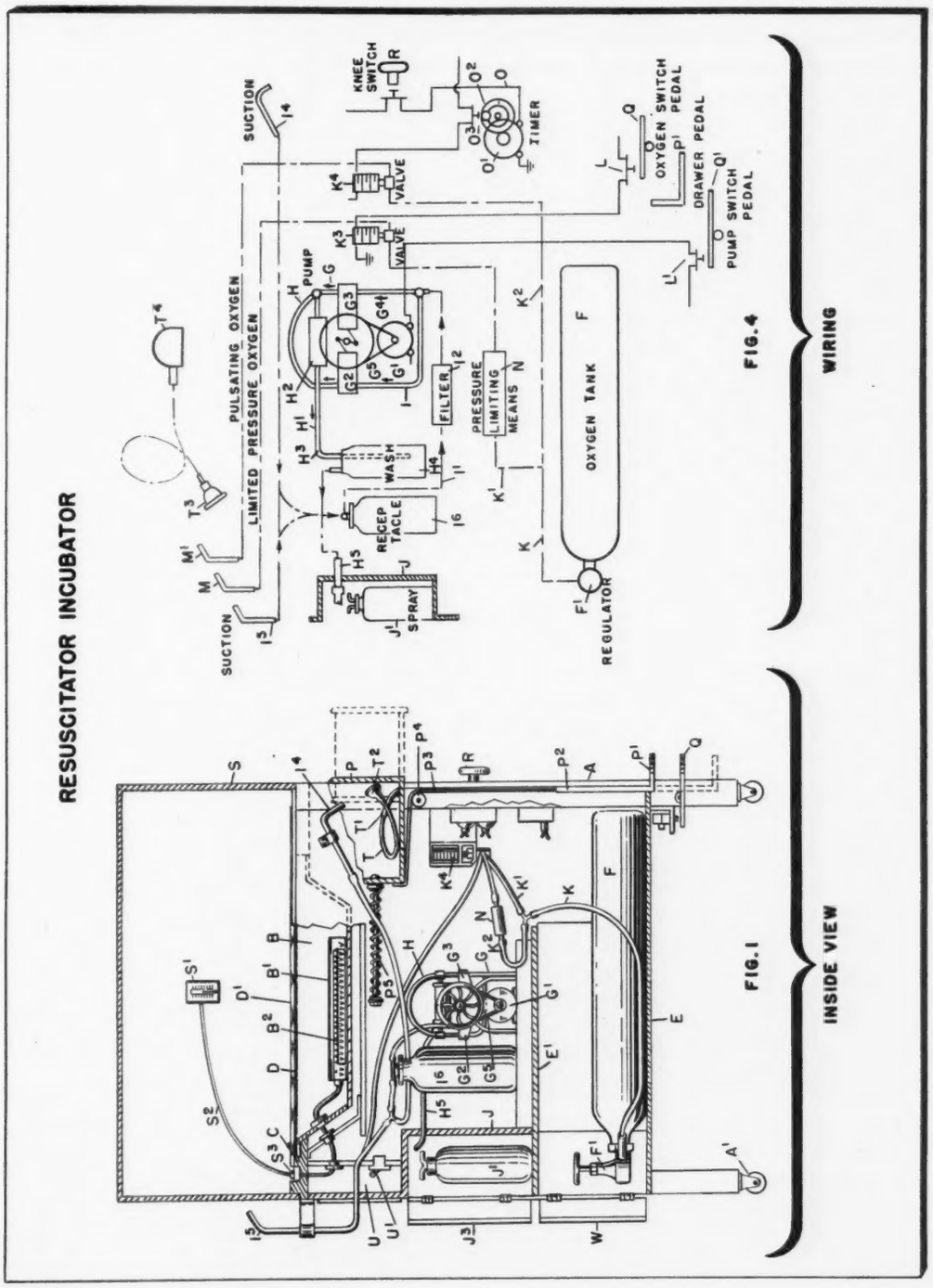

FIG. 1.

used during the delivery. On the side of the unit is a spray apparatus which makes use of the suction-pressure apparatus and can be used to spray the mother with antiseptic solution. The oxygen tank is of the large type, making it possible to transfer the entire apparatus to the nursery without the use of outside tanks. This can be done by disconnecting the electric or cord which plugs the apparatus into an ordinary electrical socket and re-connecting the apparatus in the nursery. The insulation provided in the construction of the incubator insures enough retained heat to allow for the break of electric heating current for a short period during transfer. Finally the apparatus contains an adaptor into which may be plugged an accessory oxygen tank if necessary.

SUMMARY

The author has devised an apparatus for resuscitation and immediate management of the newborn infant which has the following advantages: (1) It concentrates all resuscitation and immediate management facilities for the newborn in a compact, portable and relatively inexpensive apparatus. (2) It enables the obstetrician with little or no assistance to manage the newborn infant and to resuscitate it without a break in sterile technic so that he can administer at the same time to the mother if necessary.

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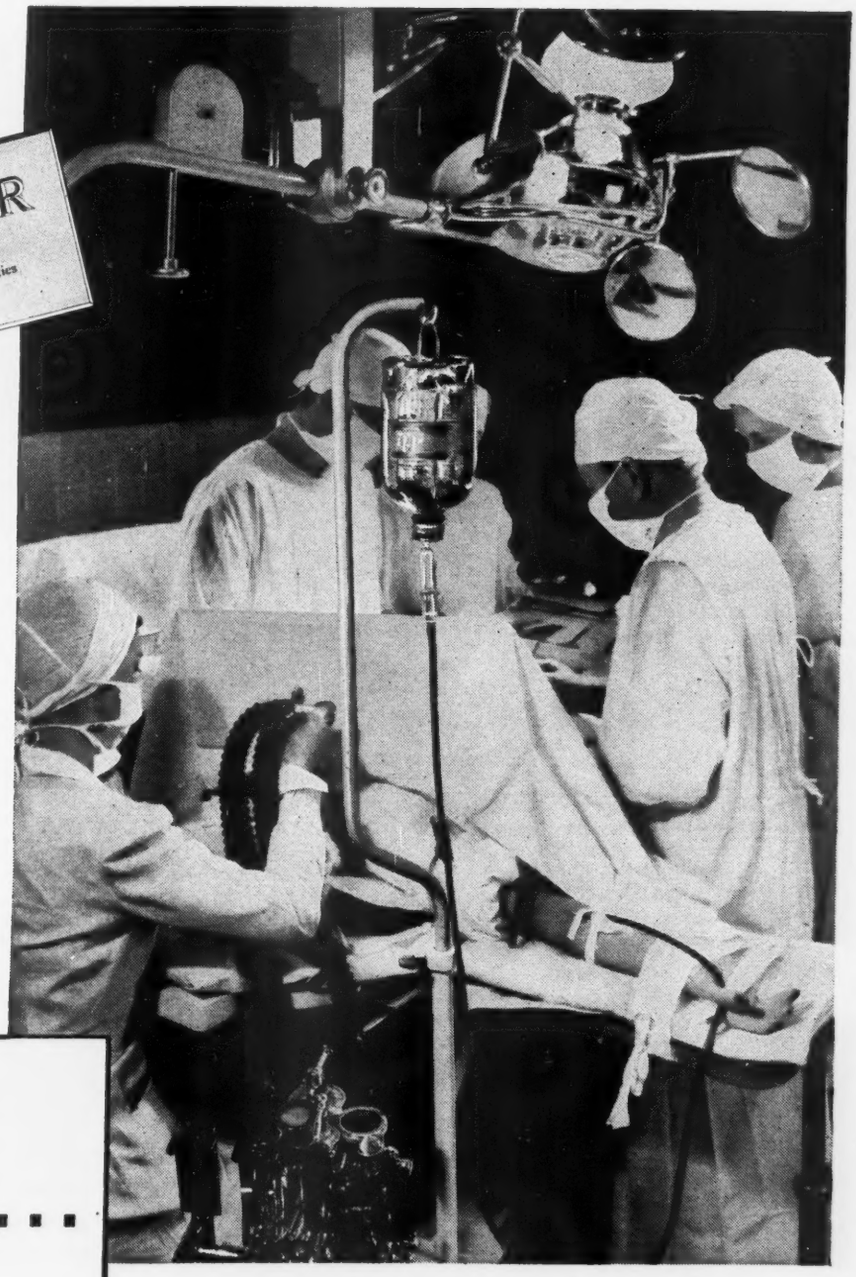

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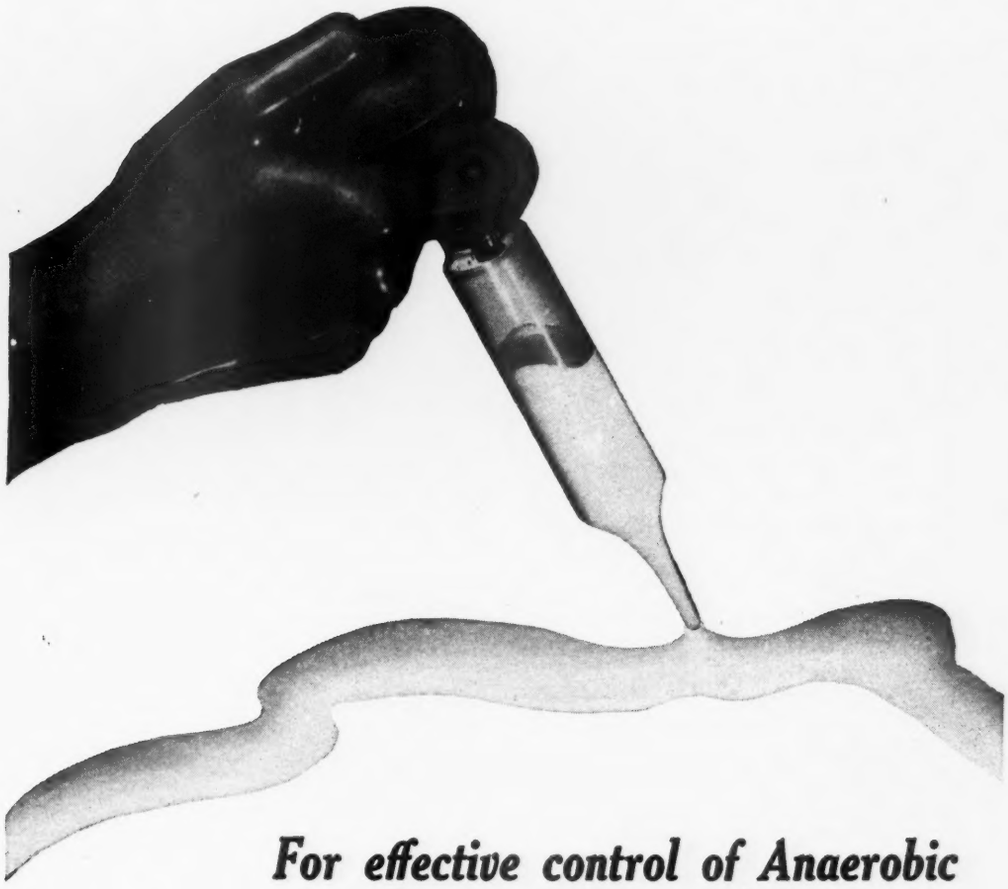

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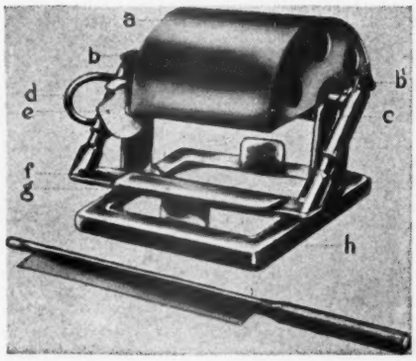


By means of this unique instrument a sheet of skin of uniform thickness may be cut at any predetermined level the size of the drum (4 x 8 inches) from any area of the body. Those who have used the dermatome state that it simplifies the technique and enlarges considerably the whole field of skin grafting. Same blade used for drum may be placed in handle and used to cut razor grafts or for honing blade. Rubber cement for the drum and donor area also is available, as well as a knife sharpening service.

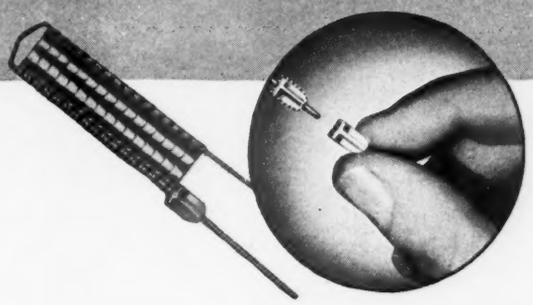
Manufactured and sold by

The Kansas City Assemblage Company

609 EAST 17th ST., KANSAS CITY 8, MO.

PROPPER BRAND MICHEL WOUND CLIPS

have a *Plus* value



Manufactured of finest 18% non-corrosive nickel silver, these precision-made clips are unexcelled for uniformity of angulation, needle-sharp points, desired bending strength and durability.

AVAILABLE IN 11, 14, 16, 18 AND 22 MM. SIZES

They feature a patented "Anchor"

Affixed to one end of the gang wire, this practical innovation offers the following advantages—

1. The "Anchor" may readily be slid off the wire or repositioned by finger pressure . . . the required number of clips freely removed . . . remaining clips retain their factory-new characteristics for future use.
2. The gang wire need never be bent to disengage or secure remaining clips, thus no series of humps are developed in the wire which might hinder removal of further needs.
3. As no snipping of wire is necessary, there is virtually no possibility of pricking the finger or puncturing a rubber glove on resultant burrs.

Your dealer can supply you

PROPPER MANUFACTURING CO., 10-34 44th DRIVE, LONG ISLAND CITY 1, N. Y.

Woven with Cotton and "VINYON E" *for Greater Elasticity!* "ALOE" Cotton Elastic Bandage

Provides even, uniform, steadily maintained pressure—remains elastic

Aloe cotton elastic bandages are woven of long staple cotton and "VINYON E"—a vinyl resin yarn—which has been found to produce a superior type of elastic bandage because of its natural elasticity. These improved elastic bandages will provide even, uniform, easily controlled and steadily maintained pressure in all conditions where an elastic bandage is indicated. High quality feather-edge prevents binding. Special weave permits free movement, ventilation and circulation. Unlike most other elastic bandages, Aloe cotton elastic bandages with "VINYON E" do not have to be washed daily in order to retain their elasticity. Washing need only be done when bandage becomes soiled. Each size bandage listed below measures approximately 5½ yards when stretched and is furnished with two metal clips in cellophane wrapped and sealed package.

	Each
PH5934—Aloe Cotton Elastic Bandage with "VINYON E," 2-inch width	**$0.70**
PH5935—Same, 2½-inch width	**.85**
PH5936—Same, 3-inch width	**.95**
PH5937—Same, 4-inch width	**1.25**

A. S. ALOE COMPANY

1831 Olive St. • St. Louis 3, Mo.

ETHER *and* SUCTION *and* TREATMENT APPARATUS

The illustration shows a very popular model with many outstanding features—indirect-drive pump, overflow trap, explosion-proof motor, non-arcing switch, sound-proofed cabinet equipped with vacuum gauge and regulator, snap-fit suction and ether bottles, sinus cleanser, and sprays.

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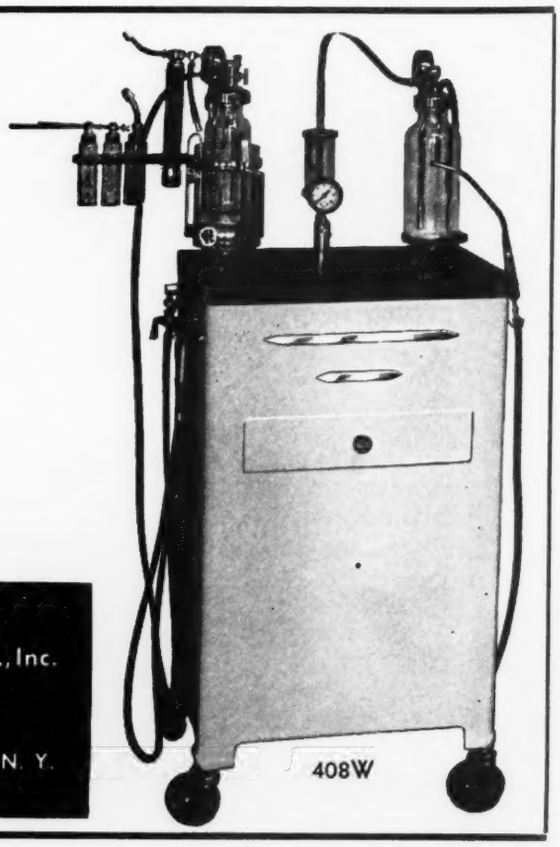


C. M. SORENSEN CO., Inc.

Factory, General Office and Showroom

403 EAST 62nd ST. NEW YORK 21, N. Y.

THE EINHORN BILUMEN GASTRO-ENTEROSTOMY TUBE

(Bucketless)

as described by Dr. Moses Einhorn, New York, in Surgery, Gynecology and Obstetrics, Jan. 1941.

SPECIFICATIONS . . . D-103 GASTRO-ENTEROSTOMY TUBE. Round tube is made of special rubber, 48" long, 16 French, bisected by a center wall to give a double semi-circular lumen. Supplied with double metal outlet and rubber connectors. Each lumen can be used independently since they have separate openings at both ends.

Catheter type tip is lead impregnated solid rubber 2½" long. Next to this tip the longer lumen (jejunal) has 3 oval slotted openings ½" apart.

The shorter lumen (stomach) has 3 oval slotted openings 14½" above the terminal end of the tube. Of these 14½", 2½" are lead impregnated tip and 12" lead shot impregnated solid rubber. This gives the tube the necessary weight for easy and smooth passage.

This bilumen bucketless tube is designed for post-operative use in gastro-enterostomy cases.

Before the operation the tube is passed through the patient's nose and swallowed directly until the tube is at the single (30") mark indicating that approximately 11" of the tube is in the patient's stomach.

After the anastomosis the surgeon slips the tube into the jejunum until the tube reaches the double mark (37"). In this position jejunal feeding or drainage and gastric drainage can be carried out simultaneously or independently.

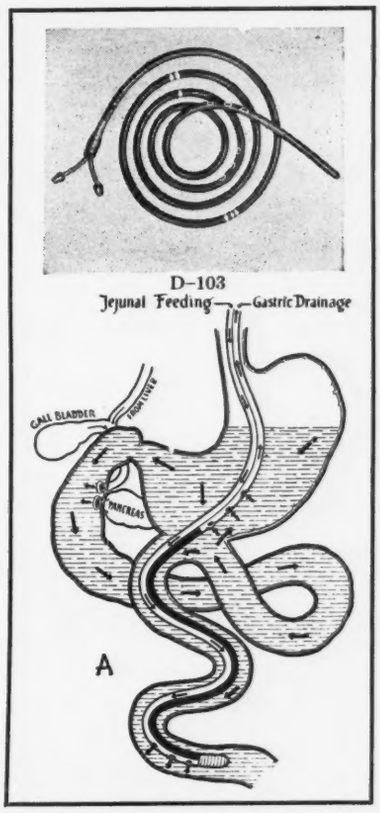
Removal and introduction of the tube are simplified by the absence of buckets which have to be attached on introducing and detached on removing by withdrawing the tube through the mouth.

D-103 EINHORN BILUMEN GASTRO-ENTEROSTOMY TUBE, special rubber, 48" long, 16 French, with double metal outlet and rubber connectors .....Each $7.50.

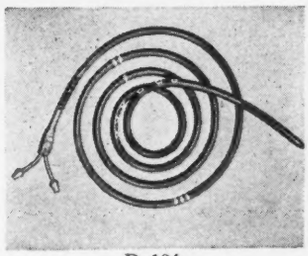
D-104 EINHORN NASAL BILUMEN GASTRO-DUODENAL TUBE, special rubber, 48" long, 16 French, lead impregnated catheter tip, markings at 19", 30" and 36½". Includes double metal outlet and rubber connectors .....Each $7.50.

D-105 EINHORN ORAL BILUMEN GASTRO-DUODENAL TUBE, similar to the above but with rubber-encased lead-weighted bucket for oral intubation.....Each $7.50.

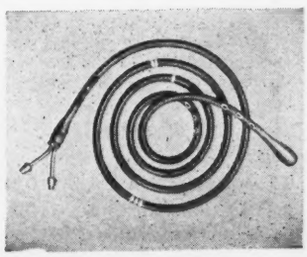
Order from your dealer



D-103



D-104



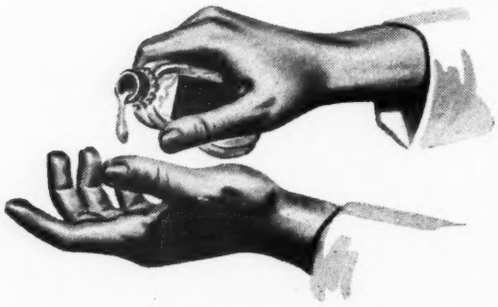
D-105

CLAY-ADAMS CO INC.

44 EAST 23rd STREET, NEW YORK, N. Y.

HOW MANY TIMES DID YOU WASH YOUR HANDS TODAY?

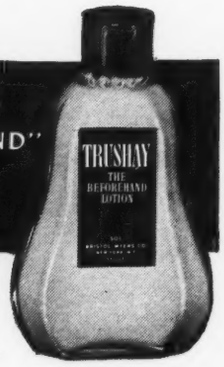
To *prevent* rough, red hands caused by frequent washing



...a few drops of TRUSHAY, applied *before* washing, gives two-fold protection:

1. **TRUSHAY forms a film over the skin surface to help guard against the harsh effects of cleansing and antiseptic agents... helps keep hands smooth and soft.**
2. **TRUSHAY fights hand infection by helping to keep skin healthy and unbroken!**

Trushay THE "BEFOREHAND" LOTION



A Product of BRISTOL-MYERS COMPANY, 19NF W. 50th St., New York 20, N. Y.

Low Tissue-Toxicity

YET POWERFULLY GERMICIDAL

Phe-Mer-Nite Tincture and Phe-Mer-Nite Solution combine high bactericidal power with notably low tissue toxicity. In preoperative skin preparation, the Tincture (1:3000 alcohol-acetone-aqueous solution) produces dependable skin sterility within 3 minutes; soap and water readily remove the residual color. Since Phe-Mer-Nite Solution (1:1000) retains its germicidal potency in the presence of blood serum, it finds many uses in everyday practice, in the hospital, and in industrial plants.

PHE-MER-NITE

(Brand of Phenylmercuric Nitrate)

Virtually nontoxic. Does not precipitate tissue proteins. Diluted 1:4 (water) the Solution sterilizes instruments and rubber gloves harmlessly in 5 minutes. This Solution may be applied to burns and other lesions requiring antisepsis. Phe-Mer-Nite Tincture and Solution are supplied in gallon and pint bottles. Surgeons are invited to send for literature and liberal clinical test samples.

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Bristol, Tenn.-Va.

NEW YORK • SAN FRANCISCO • KANSAS CITY SEMCO

Not Merely the Joints

REQUIRE TREATMENT IN ARTHRITIS

Systemic Involvements, too—
DEMAND CONSIDERATION

Weakness • Fatigability • Loss of Weight • Anemia
Neuritis • Gastrointestinal Disturbances • Liver Dysfunction
Impaired Carbohydrate Metabolism • Early Arteriosclerosis

THE measurable improvement, systemic as well as articular, which usually follows the use of Darthron is due to its pharmacodynamic influence which is exerted not only on the joints but also on the general systemic state.

Maximal improvement in the shortest time may be achieved only when efficiency of all metabolic and physiologic activity is raised to and maintained at optimal levels.

The pharmacologic influence of each of its nine active ingredients, upon which the rationale of the Darthron formula is based, is time-tested and clinically proved. The need for each is well established.

Darthron supplies in a single capsule all nine of these essentials. By eliminating the need for taking a number of different medicaments, Darthron makes for convenience in administration and better patient cooperation. Physicians are invited to send for a complimentary copy of the new brochure "Systemic Therapy in the Arthritides."

J. B. ROERIG & COMPANY
536 Lake Shore Drive • Chicago 11, Illinois

Each Capsule Contains:

Vitamin D	50,000 U.S.P. Units
Vitamin A	5,000 U.S.P. Units
Ascorbic Acid	50 mg.
Thiamine Hydrochloride	2 mg.
Riboflavin	1 mg.
Pyridoxine Hydrochloride	0.1 mg.
Calcium Pantothenate	0.333 mg.
Niacinamide	10 mg.
Mixed Natural Tocopherols	3.4 mg.

DARTHRON *for the Arthritic*
a **ROERIG** *Preparation*

IN THE PREPARATION FOR

Elective Surgery

When surgical intervention is not a matter of emergency, much can be gained by improving the patient's nutritional state. The impact of anesthesia and surgical manipulation are more easily borne, prognosis is improved, and the recovery period may be shortened, when bodily stores and plasma levels of essential nutrients are brought to and maintained at high levels.

In the preparation of the patient for elective surgery Ovaltine can be of signal service. Three glassfuls of this palatable food drink added to the daily diet will readily bring the intake of nutritional essentials to the point desired. Its rich content of biologically adequate protein, vitamins, minerals, and readily assimilated caloric food energy will rapidly replenish bodily stores and increase the glycogen content of the liver, thus lessening the surgical hazard.

THE WANDER COMPANY, 360 N. MICHIGAN AVE., CHICAGO 1, ILL.

Ovaltine

Three daily servings of Ovaltine, each made of ½ oz. Ovaltine and 8 oz. of whole milk,* provide:

PROTEIN	31.2 Gm.	VITAMIN A	2953 I.U.
CARBOHYDRATE	62.43 Gm.	VITAMIN D	480 I.U.
FAT	29.34 Gm.	THIAMINE	1.296 mg.
CALCIUM	1.104 Gm.	RIBOFLAVIN	1.278 mg.
PHOSPHORUS	.903 Gm.	NIACIN	7.0 mg.
IRON	11.94 mg.	COPPER	.5 mg.

*Based on average reported values for milk.

For Surgical Antisepsis

Zephiran Chloride is a germicide of high bactericidal and bacteriostatic potency. In proper dilutions it is nonirritating and relatively nontoxic to tissue cells.

Zephiran Chloride possesses detergent, keratolytic and emulsifying properties, which favor penetration of tissue surfaces, hence removing dirt, skin fats and desquamating skin.

INDICATIONS

Zephiran Chloride is widely employed for skin and mucous membrane antisepsis—for preoperative disinfection of skin, denuded skin and mucous membranes, for vaginal instillation and irrigation, for vesical and urethral irrigation, for wet dressings, for irrigation in eye, ear, nose and throat infections, etc.

HOW SUPPLIED

Zephiran Chloride is available in
TINCTURE 1:1000 Tinted
TINCTURE 1:1000 Stainless
AQUEOUS SOLUTION 1:1000
in 8 ounce and 1 gallon bottles.

Write for informative booklet

WINTHROP CHEMICAL COMPANY, INC.
Pharmaceuticals of merit for the physician
NEW YORK 13, N. Y. • WINDSOR, ONT.

ZEPHIRAN CHLORIDE
"Zephiran" Trademark Reg. U.S. Pat. Off. & Canada
Brand of BENZALKONIUM CHLORIDE REFINED

"TOO LITTLE and TOO LATE"

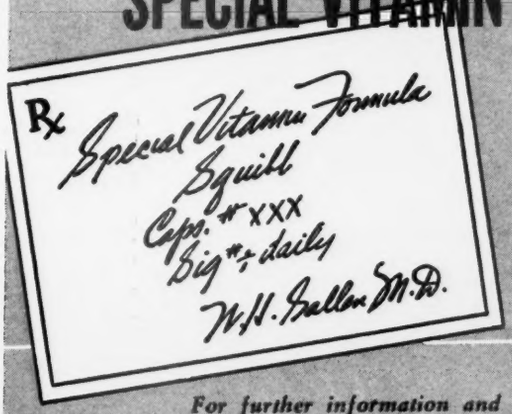
"TOO LITTLE and too late" can be as disastrous in therapy as in warfare. This, it is now realized, is especially true in nutritive failure, where frequently it is too much to expect that a balanced diet alone will not only supply the patient's daily requirements but will also be able to compensate for deficiencies of long standing.

When nutritive failure calls for vigorous therapeutic measures, two main desiderata must be considered —the *strength* of the polyvitamin preparation prescribed, and the *balance* of its ingredients. An admirable guide for such therapy is provided by the new nutritional yardstick—the daily Recommended Dietary Allowances of the Food and Nutrition Board of the National Research Council—arrived at by a group of fifty leading experts on nutrition.

Squibb Special Vitamin Formula in a dose of one capsule daily provides the *full* daily Recommended Dietary Allowances of vitamins. For enriching restricted diets in convalescence and for therapy in mild multiple vitamin deficiencies it offers you a convenient and economical means of providing a dietary supplement of high potency and balanced formula.

Special Vitamin Formula is a nonproprietary name, easy to remember. You may prescribe as many or as few of these capsules as you consider desirable without affecting the low cost to the patient—only 5¢ to 6¢ per capsule — since they are supplied to druggists in bulk. Be sure to specify. . . .

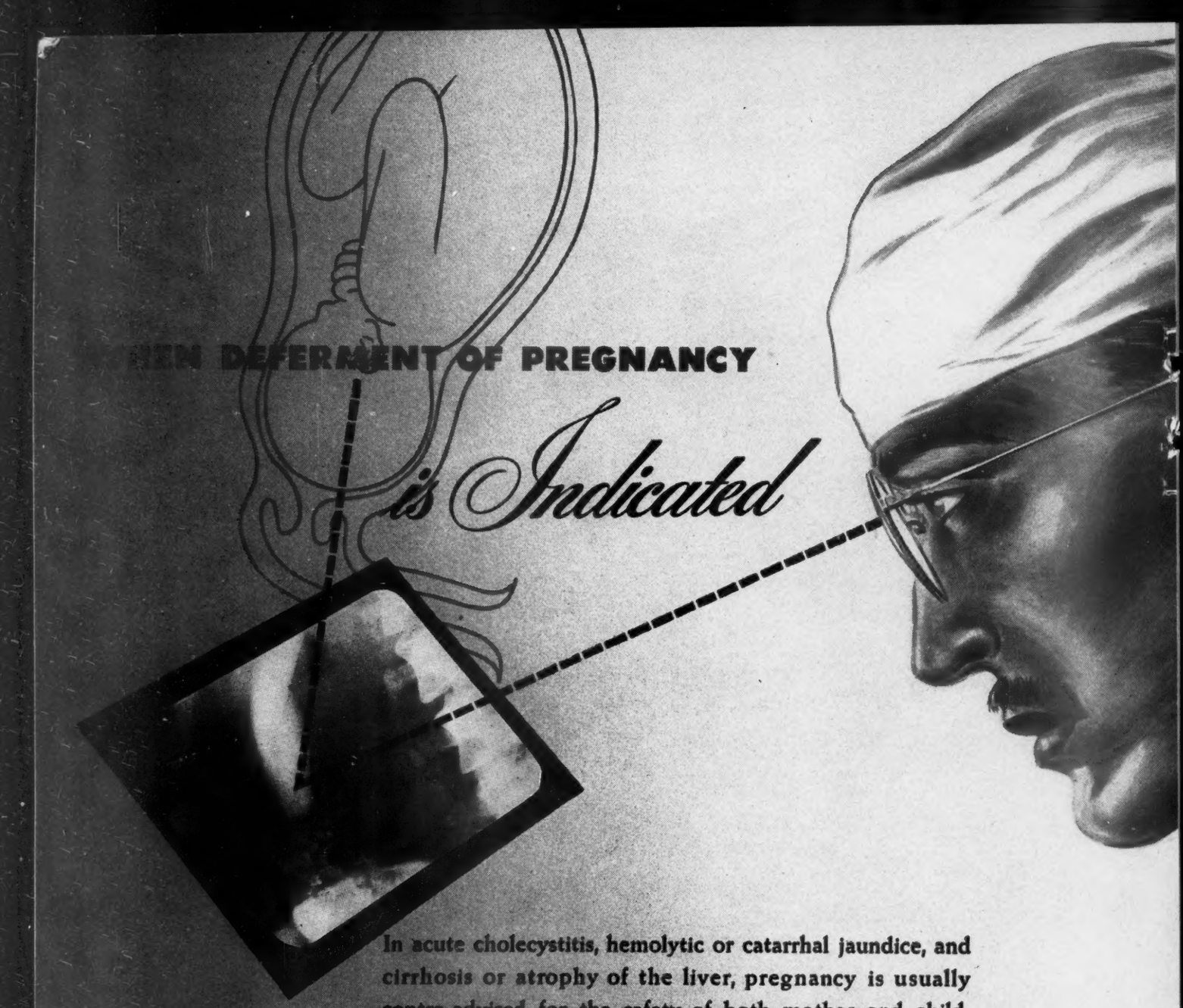
SPECIAL VITAMIN FORMULA SQUIBB



Each Capsule contains:

5000 Units Vitamin A
800 Units Vitamin D
2 Mg. Thiamine Hydrochloride
3 Mg. Riboflavin
20 Mg. Niacinamide
75 Mg. Ascorbic Acid

For further information and literature address Professional Service Department, E. R. Squibb & Sons, 745 Fifth Ave., New York 22, N. Y.



WHEN DEFERMENT OF PREGNANCY

is Indicated

In acute cholecystitis, hemolytic or catarrhal jaundice, and cirrhosis or atrophy of the liver, pregnancy is usually contra-advised for the safety of both mother and child. • This holds true also for patients with symptomatic cholelithiasis, presenting severe and frequent attacks, until surgery has effected a definitive cure. For (even under most favorable conditions) childbearing seriously taxes hepato-cystic integrity, frequently disturbing gallbladder motility, cholesterol metabolism and bile salt synthesis • For the safe control of conception, Ortho-Gynol Vaginal Jelly is widely advocated. It is promptly spermicidal . . . non-irritant even on extended application . . . and esthetically appealing.

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Active Ingredients: ricinoleic acid, boric acid, oxyquinoline sulfate.

The American Journal of Surgery

ADVERTISERS INDEX

Instruments and Apparatus

A. S. Aloe Company 40
Austenal Laboratories, Inc. ..... December
Becton, Dickinson & Co ..... December
Crescent Surgical Sales Co., Inc. 8
The Birtcher Corp 11
Fred Haslam & Co., Inc. 34
Kansas City Assemblage Co. 39
Kny-Scheerer Corporation 6
Geo. P. Pilling & Son Co 15
Propper Manufacturing Company 39
Singer Sewing Machine Company 10
J. Sklar Manufacturing Co 12
C. M. Sorensen Co., Inc. 40
The Tower Co., Inc 13
Zimmer Manufacturing Co 14

Sutures

Bauer & Black 7
Davis & Geck, Inc. ..... Insert Facing 2nd Cover
J. A. Deknatel & Son, Inc. ..... December
Ethicon Suture Laboratories ..... Insert Facing P. 32
Gudebrod Bros. Silk Co., Inc. ..... December

Pharmaceuticals

Abbott Laboratories 20
American Hospital Supply Corp. ..... December
The Armour Laboratories ..... Insert Facing P. 16
Ernst Bischoff Co., Inc. ..... December
Burroughs Wellcome & Co. 18
Chatham Pharmaceuticals, Inc. 27
Cheplin Biological Laboratories, Inc. ..... December
Ciba Pharmaceutical Products, Inc. ..... Back Cover
Commercial Solvents Corporation ..... December
Drug Products Co., Inc. 37
E. Fougera & Co., Inc. ..... December
The Harrower Laboratory, Inc. 37
Hoffmann-La Roche, Inc. 5
Iodine Educational Bureau, Inc. 36
The Lavoris Company 36
Thos. Leeming & Co., Inc. ..... December
Eli Lilly and Company 31
The S. E. Massengill Company 43
Merck & Co., Inc. 35
The Wm. S. Merrell Company 16
McNeil Laboratories, Inc. 29
National Drug Co. ..... December
Ortho Products, Inc. 48
Parke, Davis & Co 24
J. B. Roerig & Company 44
Schering Corporation 25
Smith, Kline & French Laboratories ..... December
E. R. Squibb & Sons 22, 47
Frederick, Stearns & Company 23
The Upjohn Company 32
Myron L. Walker Co., Inc. 26
White Laboratories, Inc. 17
William R. Warner & Co., Inc. 30
Winthrop Chemical Co., Inc. 2, 46
John Wyeth & Brother, Inc. 21

Hospital Supplies

A. S. Aloe Company 40
American Hospital Supply Corp. ..... December
Becton, Dickinson & Co. ..... December
Bristol-Myers Co 42
Clay-Adams Co., Inc. 41
Cutter Laboratories 33
Fred Haslam & Co., Inc. 34
Johnson & Johnson 19
Macalaster Bicknell Company 28
Mallinckrodt Chemical Works ..... December
Owens-Corning Fiberglas Corp. 9
J. Sklar Manufacturing Co 12
C. M. Sorensen Co., Inc. 40
The Tower Co,, Inc. 13

Post-Graduate Instruction

Cook County Grad. Sch. of Med. 38
N. Y. Polyclinic Med. School 38

Foods

Cereal Institute Inc. ..... December
The Wander Company 45

Books

Froben Press 1

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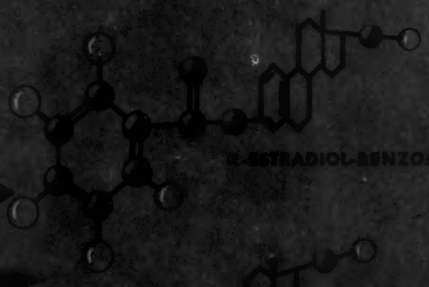

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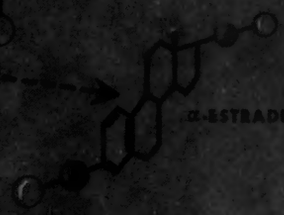

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